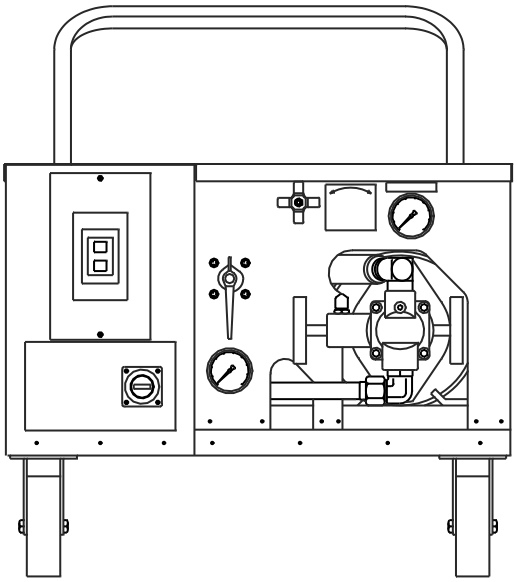
# Operation & Service Manual



## Model: 5010
## Hydraulic Power Unit

05/2004 - Rev. 01

**Includes Illustrated Parts Lists**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| REVISION | DATE | TEXT AFFECTED |
| --- | --- | --- |
| 01 | 5/2004 | pg. 24 Modified part number on item |

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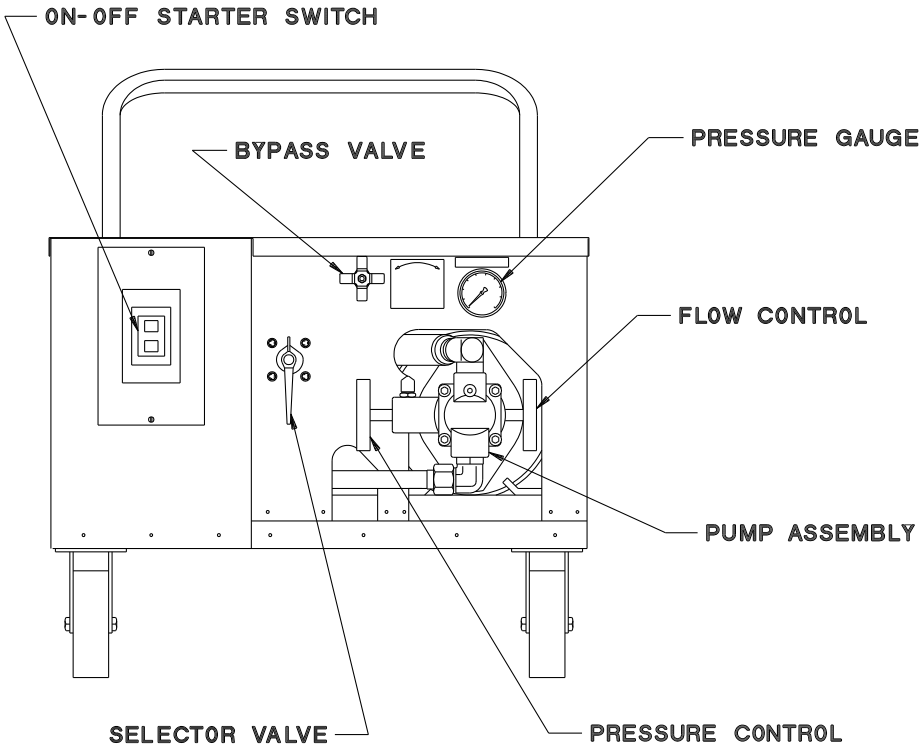



**FIGURE 1 – External Components**

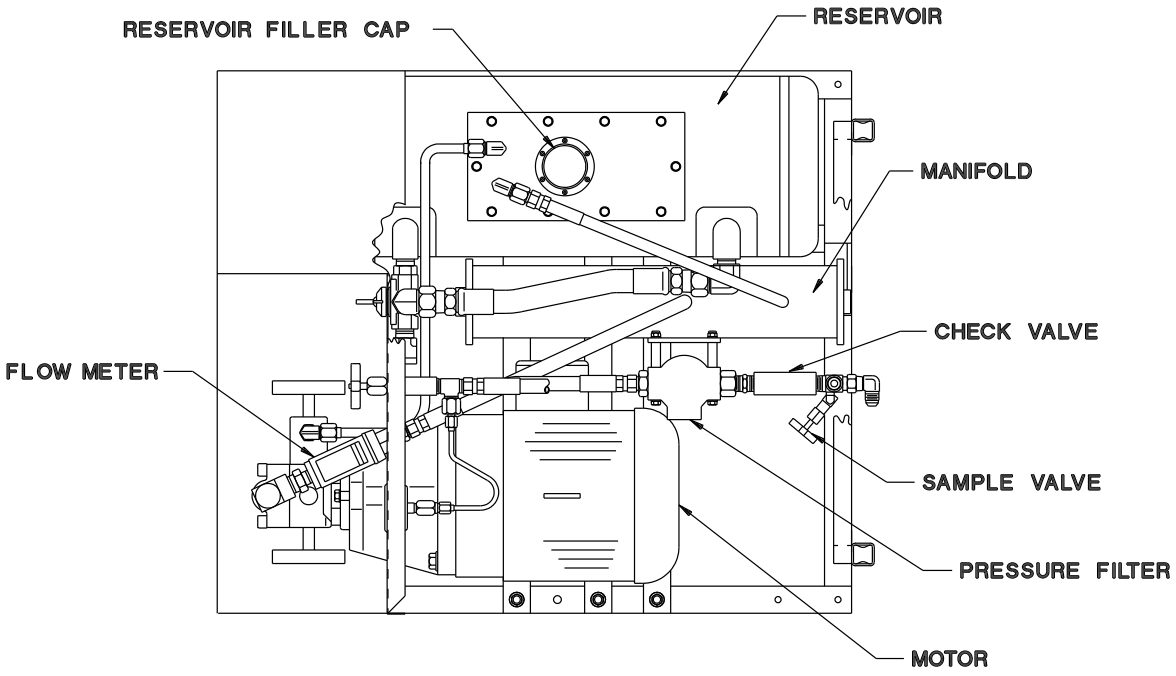



**FIGURE 2 – Internal Components**

# Hydraulic Schematic

**(Standard Models)**

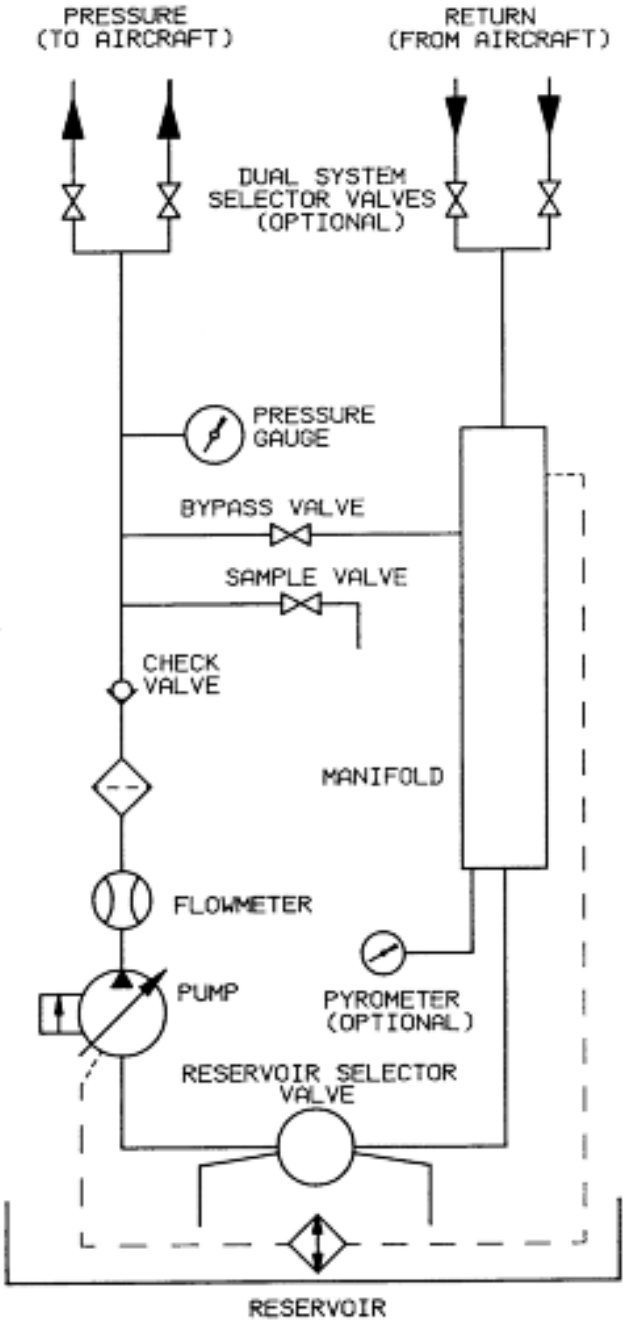
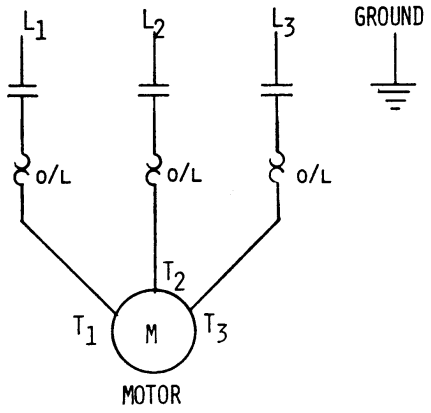



**FIGURE 3 – Hydraulic Schematics**




DUAL INPUT VOLTAGE CONNECTION

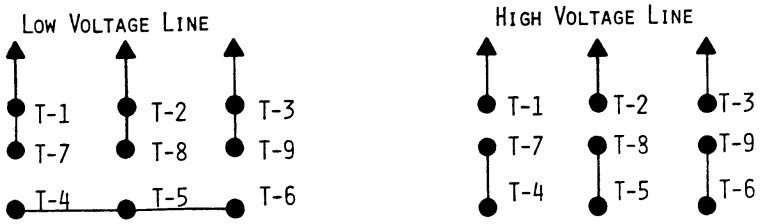



**FIGURE 4 – Electrical Schematic**

This product can not be modified without the written approval of Tronair, Inc. Any modifications done without written approval voids all warranties and releases Tronair, Inc., it suppliers, distributors, employees, or financial institutions from any liability from consequences that may occur. Only Tronair OEM replacement parts shall be used.

## 1.0 GENERAL DESCRIPTION

The Tronair Hydraulic Power Unit (HPU) provides a source of clean, pressurized hydraulic fluid for performing required aircraft maintenance.

Important features include:

- Pressure compensated pump with integral pressure and flow controls
- 10 gallon reservoir with selector valve
- Bypass valve
- Cooler located inside reservoir
- Manual starter with overload protection
- Non bypass filter with 2 micron filter element

## 2.0 TECHNICAL SPECIFICATIONS

### 2.1 HYDRAULIC

**Fluid:** MIL-PRF-5606
**Pressure Range:** 300 – 1,750 psi
**Flow Range:** 0 – 6 gpm (60 Hz systems)
0 – 5 gpm (50 Hz systems)
**Filtration:** 2 Micron Absolute, Non-Bypass
**Reservoir Capacity:** 10 gallons (Maximum)

### 2.2 ELECTRICAL

**Power Requirements:** 3 Phase, Alternating Current

| ***60 Hz*** | ***50 Hz*** |
|---|---|
| 9.2 amps @ 208 VAC | 9.3 amps @ 220 VAC |
| 8.4 amps @ 230 VAC | 4.6 amps @ 380, 415, 440 VAC |
| 4.2 amps @ 460 VAC | |
| 3.7 amps @ 575 VAC | |

### 2.3 MECHANICAL

**Dimensions**

**Length:** 35 inches
**Width:** 30 inches
**Height:** 24 inches
**Weight:** 400 lbs

## 3.0 PREPARATION FOR USE

The HPU is shipped completely assembled and only the following steps are required to make the unit operational.

### 3.1 SERVICING RESERVOIR

Remove the sheet metal cover and fill the reservoir with the correct fluid until fluid level is slightly above the minimum oil level mark. Since a case drain cooler is located in the HPU reservoir, it is important that this fluid level be maintained in order to prevent excessive heat buildup.

### 3.2 CONNECTING ELECTRICAL LEADS

Install plug onto the electrical cord and check for proper motor rotation by "bumping" the On-Off switch. Correct motor rotation is indicated by an arrow on pump motor adapter. If rotation is not correct, change any two of the three input leads inside the on-off switch box or at the plug.

***NOTE: Balanced three phase voltage must be available to prevent overheating and damage to the motor. Voltage unbalanced between phases occurs when the voltages differ from one another. Some reasons for imbalance are:***

1. ***Unequal loading of each phase.***
2. ***Poor connections in the supply.***
3. ***Single phase condition caused by blown fuses or bad connections.***

***If these conditions occur in the incoming power system, a protective device, such as a voltage monitor, should be installed on the machine to prevent motor damage.***

## 4.0 OPERATION

Due to the complexity, differences, and ongoing changes in aircraft hydraulic systems, no attempt has been made to relate to any specific aircraft operation. It is suggested that this manual and the HPU be studied thoroughly in order to obtain optimum benefit of the various features. By combining an understanding of the HPU and the aircraft hydraulic system, many services not mentioned in this manual may be performed. Refer to the hydraulic schematic, front panel controls, and internal components pages for clarification while reading this manual.

### 4.1 GENERAL COMMENTS

Most questions or problems concerning hydraulic power units are usually caused by improper training or understanding of hydraulics. The following comments are given to aid in obtaining maximum benefits from the hydraulic power unit.

#### 4.1.1 Training

Be sure that all personnel that will use the machine read the operating manual and receive training. We encourage customers to call Tronair to discuss any operating or testing requirements.

#### 4.1.2 Use of the HPU Reservoir

It is suggested that the integral reservoir be used whenever possible. Use of this reservoir eliminates any possibility of cavitating the pump. Most complaints of pump noises are due to fluid restrictions in the aircraft systems when using the aircraft reservoir. Also, if the integral reservoir is used, the HPU will run considerably cooler. This occurs because the pump case drain oil is directed to the reservoir instead of the pump return. The only compromise in using the HPU reservoir is that the aircraft system reservoir must be serviced after testing, which is standard procedure.

### 4.2 PRELIMINARY ADJUSTMENTS AND OPERATIONS

The following are basic to the operation of the HPU and should be thoroughly understood. The pressure and flow controls have lock nuts to prevent rotation of the control shafts during operation. These nuts should be moved away from the pump during adjustments of flow or pressure in order to eliminate binding of the control shafts.

#### 4.2.1 Flow Control Adjustment

a. Open bypass valve.
b. Select "Hydraulic Power Unit" position with reservoir selector valve.
c. Start HPU.
d. Adjust flow control for maximum desired flow. Observing the flowmeter, read flow (gallons per minute) directly from flowmeter scale. Be sure the control shaft lock nut is loose during adjustment. Tighten after adjustment to maintain setting.

#### 4.2.2 Pressure Control Adjustment

a. Open bypass valve.
b. Select "Hydraulic Power Unit" position with reservoir selector valve.
c. Start HPU.
d. Close bypass valve.
e. Adjust pressure control for desired pressure. Be sure the control shaft lock nut is loose during adjustment. Tighten after adjustment to maintain setting.

***NOTE: Once the flow and pressure controls have been adjusted, it is not necessary to change these settings after each operation unless desired.***

#### 4.2.3 Reservoir Selector Valve Operation

Operation of the reservoir selector valve allows the operator to select either the aircraft reservoir (closed loop) of the HPU reservoir (open loop).

**CAUTION!**

**The reservoir selector valve should only be operated when the HPU is not running. The operation of the reservoir selector valve should be done prior to starting the HPU.**

##### 4.2.3.a Aircraft Reservoir Position (Closed Loop)

In this position, the HPU is dependent on the aircraft reservoir and system for an adequate supply of fluid. Cavitation, due to an inadequate fluid supply from the aircraft, may be indicated by erratic indication of the system pressure gauge or flowmeter. Usually, the aircraft fluid supply will be restricted due to small return oil lines in the aircraft. Sometimes this problem can be minimized or eliminated by pressurizing the aircraft reservoir with air.

**CAUTION!**

**If the aircraft reservoir is pressurized, do not exceed the aircraft manufacturer's recommendations.**

If the aircraft reservoir cannot be pressurized or the cavitation persists, decrease the flow control setting until the cavitation is eliminated.

4.2.3 Reservoir Selector Valve Operation ***(continued)***

4.2.3.b HPU Reservoir Position (Open Loop)

In this position, the HPU reservoir supplies oil to the pump and accepts return oil from the aircraft. It is desirable to operate the HPU in this mode since it eliminates any possibility of cavitation.

Since the HPU reservoir is vented to atmosphere and the aircraft is at a higher level, it is normal for the aircraft reservoir to drain into the HPU reservoir. It is, therefore, necessary to be sure that sufficient room is available in the HPU reservoir to accommodate the additional fluid.

**CAUTION!**

**The aircraft system reservoir must be serviced after completion of operational testing.**

In the "HPU Reservoir" position, faster landing gear swings are usually possible since there is no restrictions to flow at the pump inlet.

On most aircraft, the aircraft reservoir may usually be serviced by disconnecting the return hose. Normally servo leakage or operation of a hydraulic component will allow some flow to the aircraft reservoir. Caution should be observed if this method is used.

**WARNING!**

- **When using the HPU reservoir, it may be possible to overfill the aircraft reservoir if several landing gear swings are done in a short time period.**
- **Always wait approximately 15 seconds between gear swings to allow the aircraft reservoir to drain into the HPU.**
- **Do not change the reservoir selector valve position while the machine is running**

4.2.4 Bypass Valve Operation

The bypass valve is used for unloading the pump flow in conjunction with the flowmeter.

4.2.4.a Start Up Operation

The bypass valve should be opened prior to starting the HPU in order to allow the motor to start under a no load condition.

4.2.4.b Shut down Operation

Prior to shutdown, the bypass valve may be opened to bleed off any residual system pressure.

**CAUTION!**

**Excessive heat, which could damage machine components, will be generated if the bypass valve is partially opened or is used for regulating flow or pressure.**

- **Use the flow and pressure controls for regulation.**
- **Use the bypass valve for unloading the system.**

4.3 SAMPLE VALVE

A sample valve is provided on the rear of the unit to obtain a fluid sample for analysis or inspection. In order to obtain a representative fluid sample, it is suggested that American National Standard number B93.19-1972 be followed.

4.4 BLEEDING AIR FROM SYSTEM

Rapid fluctuations of the pressure gauge and flowmeter are indications of cavitation or entrapped air in the hydraulic lines and/or components. Air may enter the system when:

- Operating the unit with insufficient oil in the reservoir.
- Changing a component on the aircraft.
- Changing the hose connections and/or couplings.

**To Easily Purge the Unit of Air:**

1. Fill reservoir to recommended level.
2. Open bypass valve.
3. Place reservoir selector valve in "Hydraulic Power Unit" position.
4. Start unit and adjust flow control to maximum position.
5. Run unit for five (5) minutes and shut off.
6. If additional bleeding is required, proceed with the following steps:
   a. Connect the pressure and return hoses together. (Kits containing the necessary fitting(s) are available from Tronair)
   b. If the unit is equipped with pressure and return ball valves, open the ball valves prior to starting the unit.

*4.4 Bleeding air from system continued on following page.*

4.4 BLEEDING AIR FROM SYSTEM

**WARNING!**

**Failure to open the return ball valves will cause hose or valve rupture. Property damage and personal injury can result.**

c. Place the reservoir selector valve in the “Hydraulic Power Unit” position.
d. Open the bypass valve on the instrument panel
e. Start unit and adjust flow control to maximum position.
f. Close the bypass valve and allow the unit to run for 5 minutes.

Under some conditions where a large amount of air has entered the system, the pump may not be able to draw an initial prime and will not pump. If this occurs, it may be necessary to fill the pump inlet line with fluid.

4.5 ABBREVIATED OPERATING INSTRUCTIONS

These instructions may be used for fast reference after a thorough understanding of the HPU operation has been achieved.

4.5.1 Initial Adjustments

1. Set flow control (See Section 4.2-A).
2. Set pressure control (See Section 4.1-B).

4.5.2 Prior to Starting

1. Select reservoir valve position.
2. Open bypass valve.

4.5.3 Operation

1. Start HPU.
2. Close bypass valve.

4.5.4 Shut Off

1. Open bypass valve.
2. Stop HPU.

4.6 OPTIONS

The following options are available on some models of hydraulic power units. Refer to the appropriate option description for operation information.

4.6.1 Dual System (Option C) Operation

The dual system option allows control of fluid flow to aircraft with two hydraulic systems. The systems consist of two sets of hoses and valves located in the pressure and return systems. The valves are mounted on the rear of the hydraulic power unit and are of the 90° ball type. The valves are open when the operating handle is in line with the valve.

Although both systems may be operated simultaneously, usually only one system is required at any one time. If both valve sets are open simultaneously, the pump output will be divided between the two systems. Also, cross flow between the reservoirs may occur if a reservoir level or pressure differential exists. Select valve positions prior to starting machine.

**To Operate the Dual System**

1. Before starting machine, open pressure and return valves of the same system.

**WARNING!**

**Ensure pressure and return hoses of the same system are paired and used together.**

2. 2. After completing tests on one system, shut the machine **OFF** before selecting the second system.

**WARNING!**

**Never open or close dual system valves without shutting off the hydraulic power unit. Damage to the aircraft system or reservoir may result if either return line valve is closed while the machine is running.**

3. If equipped with the ***Dual System Crossover Check Option***, separate pressure gauges are located after each system pressure shut off valve. This allows bleed down pressures to be read when the pressure valves are closed. Follow aircraft manufacturer's instructions.

## 5.0 MAINTENANCE

### 5.1 GENERAL MAINTENANCE

- The hydraulic power unit should be maintained in a safe and clean condition at all times.
- Locate and correct the source of any and all leaks.
- Inspect hoses and electrical cord periodically for damage and wear. Replace as required.

### 5.2 FILTER MAINTENANCE

Replace the filter element annually to ensure proper cleanliness of the hydraulic system. This is a minimum requirement. Replace the return filter element at the same time the pressure filter element is being replaced.

Standard filter changes depend on how frequently the HPU is used and the cleanliness of the fluid, along with the environment to which the HPU is exposed. Periodic fluid analysis is recommended to properly determine the optimum frequency of filter element changes.

### 5.3 SELECTOR VALVE MAINTENANCE

The Reservoir Selector Valve has been assembled with special grease (Tronair #H-2132) that is compatible with Skydrol. It is recommended that this valve be disassembled and re-lubed every two (2) years, or if there is any sign of external leakage.

### 5.4 LUBRICATION

The swivel casters are equipped with grease fittings which should be lubricated annually.

### 5.5 STORAGE

In the event that the HPU will not be used for 12 months or longer, the reservoir may be drained. The unit should then be appropriately covered in order to maintain cleanliness.

## 6.0 TROUBLESHOOTING

### 6.1 NO FLOW OR PRESSURE

Flow control set too low..... Increase flow setting
Motor running in wrong direction ..... See Section 3.0 "Preparation for Use"
Insufficient oil in reservoir..... See Section 3.0 "Preparation for Use"
Air in hydraulic lines ..... See Section 4.4 "Bleeding Air From System"
Faulty pump ..... Repair or replace pump

### 6.2 FLUCTUATING PRESSURE OR FLOW

Pump cavitation..... See Section 4.2.3.a "Aircraft Reservoir Position"
Air in hydraulic lines ..... See Section 4.4 "Bleeding Air From System"

### 6.3 UNIT OVERHEATS

Low fluid level in reservoir..... See Section 3.0 "Preparation for Use"
Running unit for long time periods without .... Cycle landing gear or other components periodically or allow unit to cool.
operating aircraft components
Bypass valve partially open..... See Section 4.2.4, "Bypass Valve Operation"

***NOTES:*** ***1) Running time under deadhead condition can be increased substantially by selecting the "Hydraulic Power Unit" position; reservoir selector valve.***
***2) When a pressure compensated pump is required to hold pressure without any flow delivery (dead headed condition) it is normal for the pump case drain flow and temperature to increase. By selecting the "Hydraulic Power Unit" position of the selector valve, all of the oil in the reservoir is utilized for cooling.***

### 6.4 LOSS OF FLOW IN CLOSED LOOP

**Leaking over Reservoir Selector Valve**
Valve must be disassembled and thoroughly cleaned with alcohol. Re-lubricate with grease (Tronair part number H-2132) before re-assembled.

### 6.5 EXTERNAL LEAKAGE FROM SELECTOR VALVE

**Leaking out the front of Reservoir Selector Valve**
Valve must be disassembled and thoroughly cleaned with alcohol. Re-lube with grease (Tronair part number H-2132) before re-assembled.

## 7.0 PARTS LIST INDEX

When ordering Replacement Parts/Kits, please specify Model & Serial Number of your product.
Reference the following pages for ordering information of Replacement Parts and Kits.

| Description | Page |
|---|---|
| Bypass Valve | 17 |
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| Dual System (Option C) | 19 |
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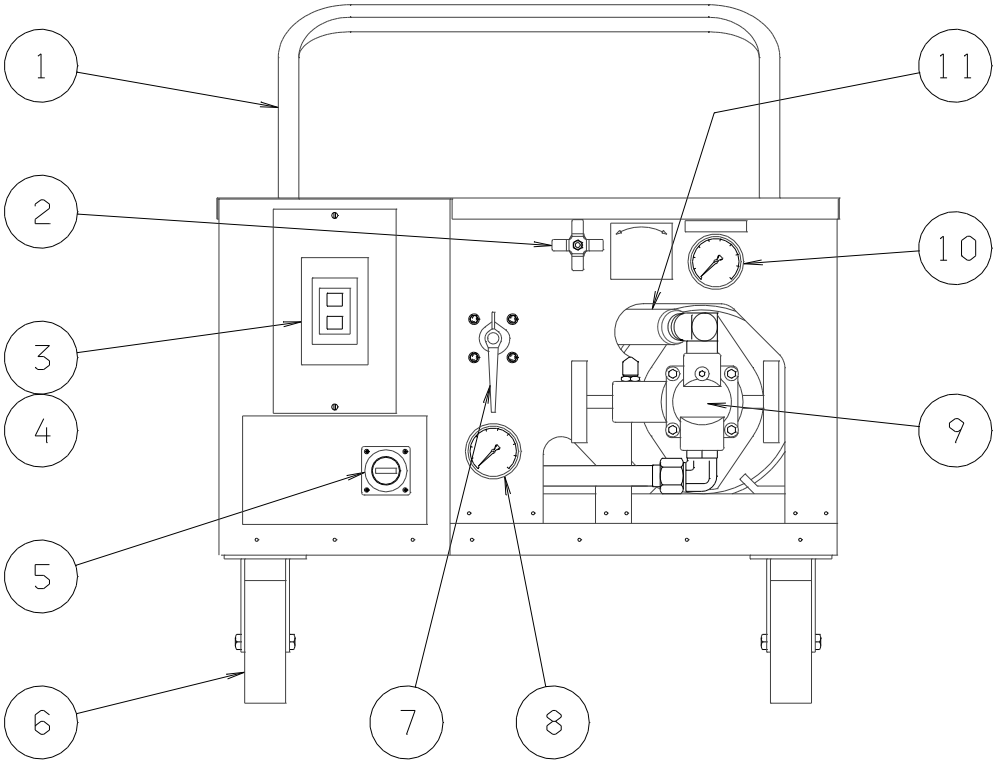
| Return Filter Assembly (Option W) | 22 |
| Sample Valve | 18 |

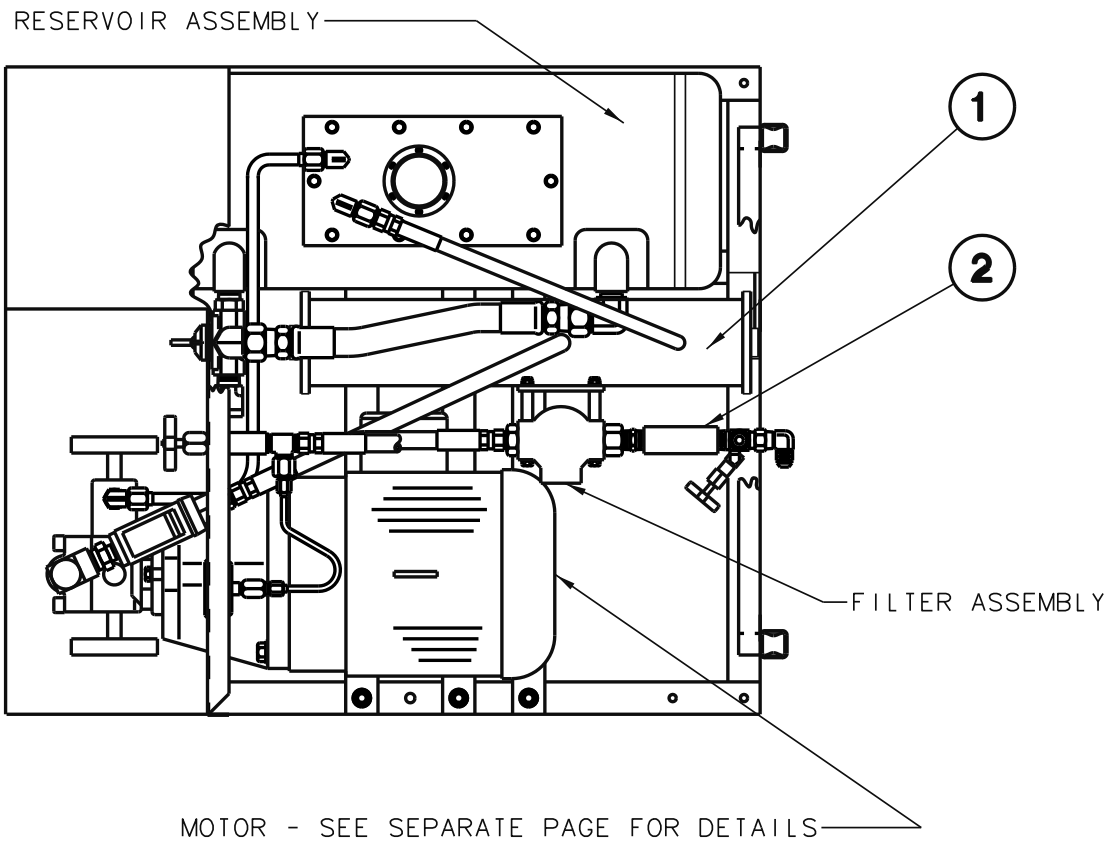
# External Components




**Part numbers given for MIL-PRF-5606 Fluid Type Units only.**

| ITEM | PART NUMBER | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | TS-1482-01 | Handle | 1 |
| 2 | HC-1056-01 | Valve, Bypass | 1 |
| 3 | EC-1044 | Switch, Starter (All Voltages) | 1 |
| 4 | *See Page 12* | Heater | 3 |
| 5 | Z-2145 | Hourmeter (Option F) | 1 |
| 6 | V-1056 | Caster - Rigid | 2 |
| 7 | HC-1074 | Valve, Selector 3/4 | 1 |
| 8 | HC-1114 | Pyrometer (Option K) | 1 |
| 9 | HC-1070-01 | Pump | 1 |
| 10 | HC-1385 | Gauge, Pressure | 1 |
| 11 | HC-2150 | Flowmeter | 1 |
| | HC-2150-A1 | Flowmeter (Calibrated) | 1 |
| *Not Shown* | TF-1037-01*180 | Hose, Pressure | 1 |
| *Not Shown* | TF-1039-01*180 | Hose, Return | 1 |

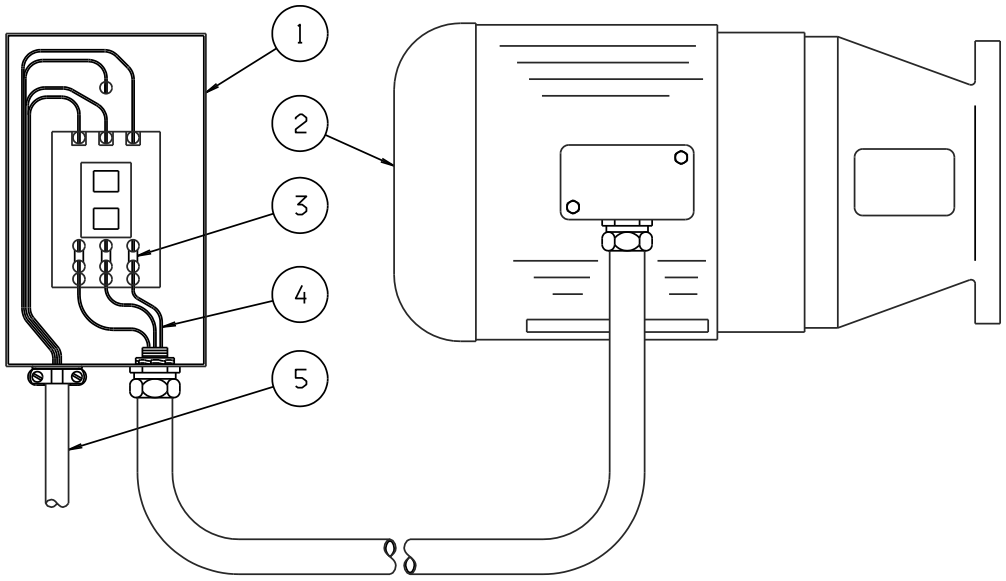
## Internal Components




**Part numbers given for MIL-PRF-5606 Fluid Type Units only.**

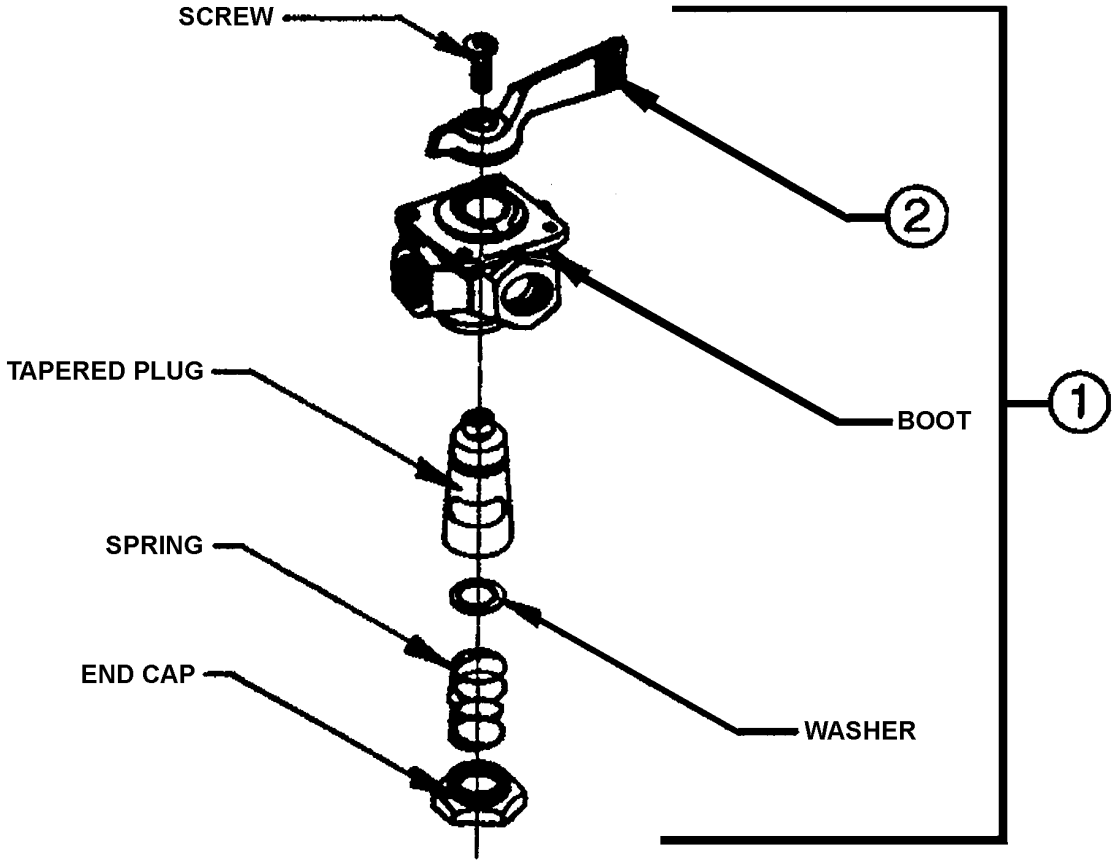
| ITEM | PART NUMBER | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | Z-1834 | Manifold | 1 |
| 2 | HC-1058 | Valve, Check | 1 |

## Electrical Components




| VAC @ 60 Hz | (1) Starter Switch | QTY | (2) Motor | QTY | (3) Heater | QTY | (4) Wire | QTY | (5) Power Cord | QTY |
|---|---|---|---|---|---|---|---|---|---|---|
| 208 | EC-1044 | 1 | EC-1186-01 | 1 | EC-1202-W51 | 3 | EC-1252-01*43.0 | 3 | EC-1170-01*0600 | 1 |
| 230 | EC-1044 | 1 | EC-1186-02 | 1 | EC-1202-W50 | 3 | EC-1252-01*43.0 | 3 | EC-1170-01*0600 | 1 |
| 380 | EC-1044 | 1 | EC-1186-01 | 1 | EC-1202-W45 | 3 | EC-1252-01*43.0 | 3 | EC-1170-01*0600 | 1 |
| 460 | EC-1044 | 1 | EC-1186-02 | 1 | EC-1202-W43 | 3 | EC-1252-01*43.0 | 3 | EC-1170-01*0600 | 1 |
| 575 | EC-1044 | 1 | EC-1186-03 | 1 | EC-1202-W41 | 3 | EC-1252-01*43.0 | 3 | EC-1170-01*0600 | 1 |
| **VAC @ 50 Hz** | **(1) Starter Switch** | **QTY** | **(2) Motor** | **QTY** | **(3) Heater** | **QTY** | **(4) Wire** | **QTY** | **(5) Power Cord** | **QTY** |
| 200 | EC-1044 | 1 | EC-1186-02 | 1 | EC-1202-W50 | 3 | EC-1252-01*43.0 | 3 | EC-1170-01*0600 | 1 |
| 220 | EC-1044 | 1 | EC-1186-02 | 1 | EC-1202-W50 | 3 | EC-1252-01*43.0 | 3 | EC-1170-01*0600 | 1 |
| 380 | EC-1044 | 1 | EC-1186-02 | 1 | EC-1202-W43 | 3 | EC-1252-01*43.0 | 3 | EC-1170-01*0600 | 1 |
| 415 | EC-1044 | 1 | EC-1186-02 | 1 | EC-1202-W43 | 3 | EC-1252-01*43.0 | 3 | EC-1170-01*0600 | 1 |
| 440 | EC-1044 | 1 | EC-1186-02 | 1 | EC-1202-W43 | 3 | EC-1252-01*43.0 | 3 | EC-1170-01*0600 | 1 |

## Reservoir Selector Valve




**Part numbers given for MIL-PRF-5606 Fluid Type Units only.**

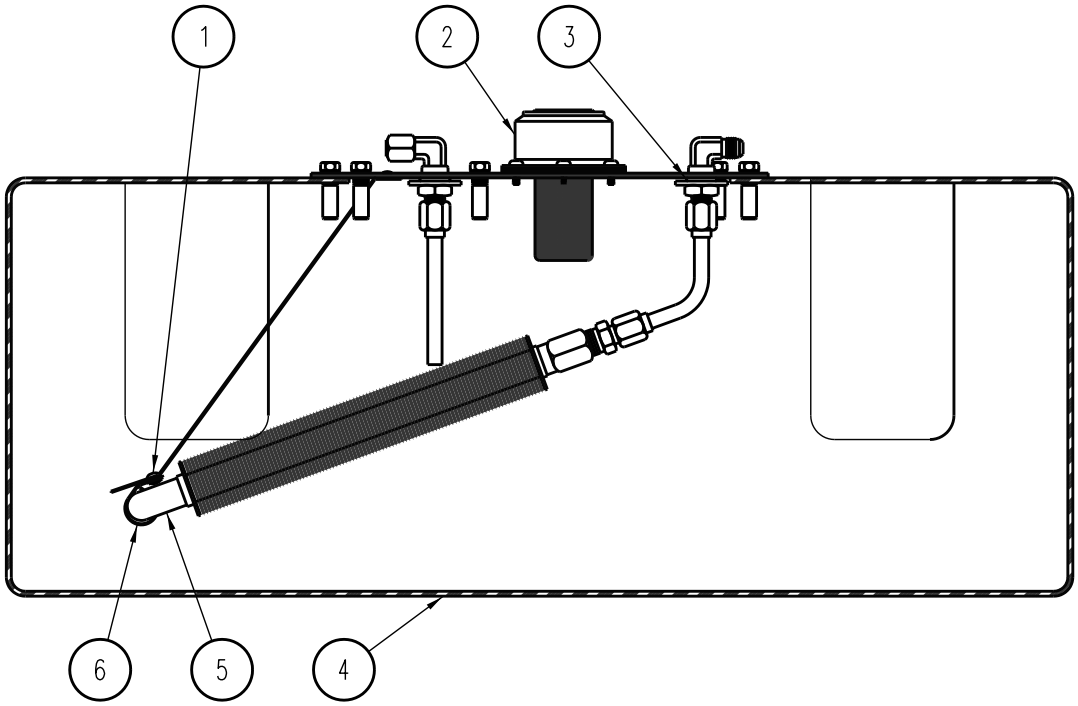
| ITEM | PART NUMBER | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | HC-1074 | Selector, Valve 3/4 | |

**VALVE REPLACEMENT PARTS**

| | | | |
|---|---|---|---|
| 2 | HC-1075 | Handle, Valve | 1 |

***NOTE: For replacement of parts other than what is listed, a complete valve (Item 1) must be purchased.***

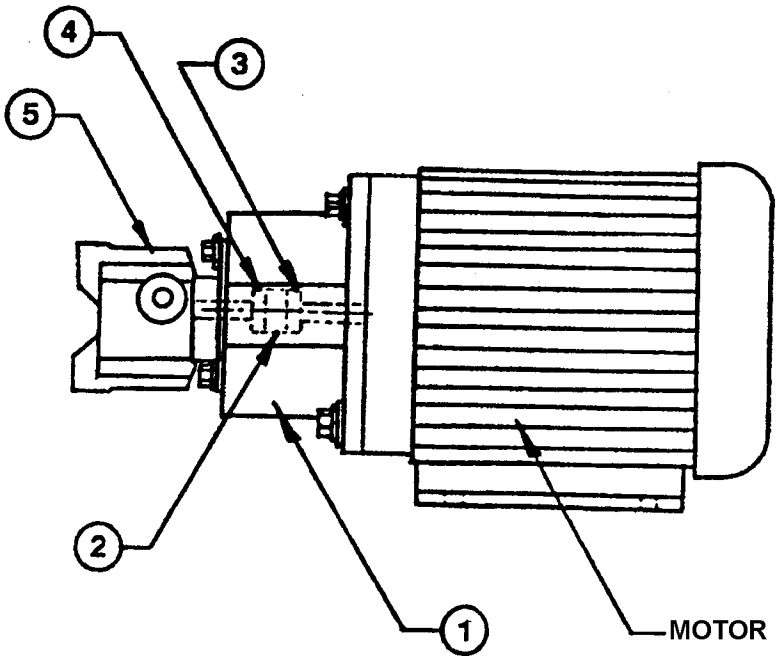
# Reservoir Sub-Assembly




**Part numbers given for MIL-PRF-5606 Fluid Type Units only.**

| ITEM | PART NUMBER | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | G-1351-04 | Rivet, 1/8" diameter x ¼" Grip | 4 |
| 2 | HC-1030 | Assembly, Filler/Breather | 1 |
| 3 | HC-2010-906 | O-ring | 2 |
| 4 | K-3708 | Kit, Reservoir | 1 |
| 5 | HC-1878 | Cooler | 1 |
| 6 | H-1721-04 | Clamp | 1 |

## Pump/Motor Assembly




**Part numbers given for MIL-PRF-5606 Fluid Type Units only.**

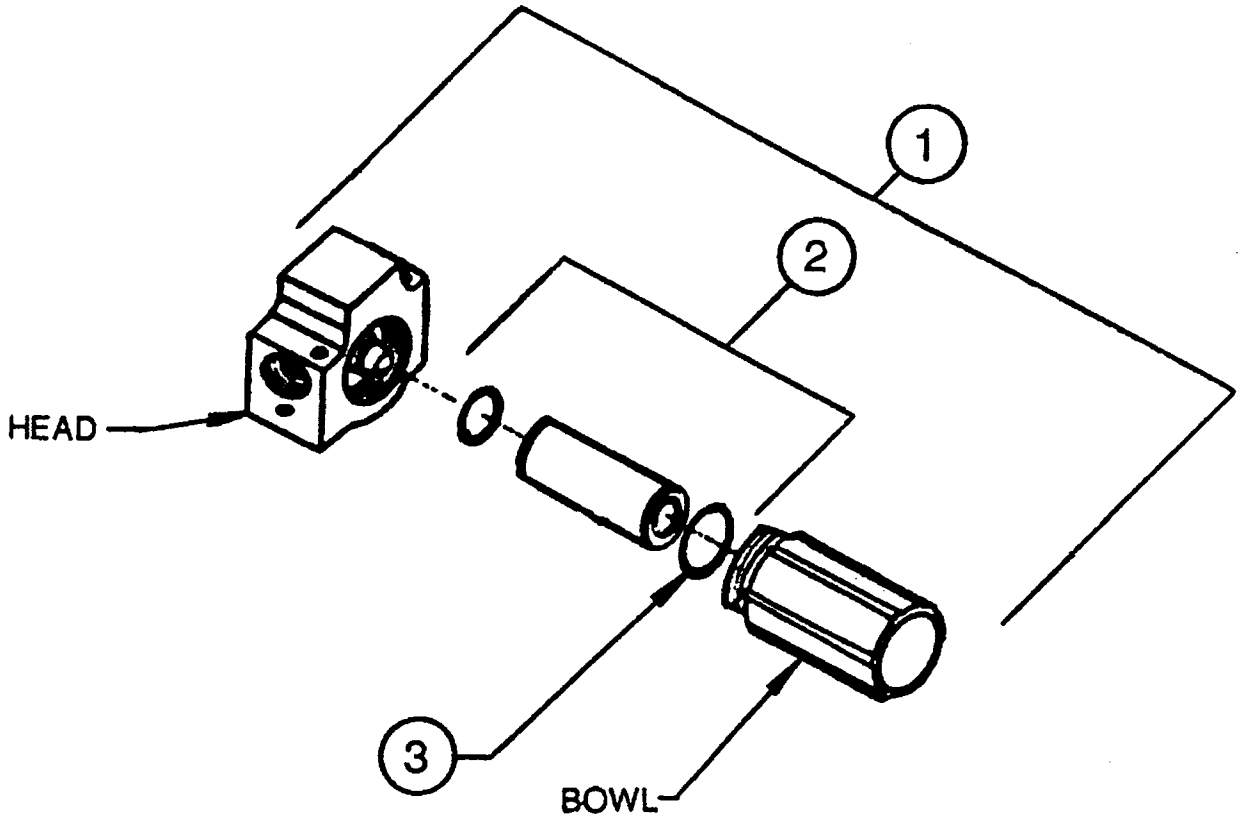
| ITEM | PART NUMBER | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | HC-1393-11 | Mount, Pump/Motor | 1 |
| 2 | H-2227 | Coupling – Spider | 1 |
| 3 | H-2224-03 | Coupling – Body (Motor) | 1 |
| 4 | H-2224-01 | Coupling – Body (Pump) | 1 |
| ♦ 5 | HC-1070-01 | Pump, Hydraulic | 1 |

**PUMP REPLACEMENT PARTS**

| | | | |
|---|---|---|---|
| 6 | HC-1816 | Seal, Shaft | 1 |
| 7 | K-1078 | Kit, Seal (Includes Item 6) | 1 |

♦ ***See Appendix III - pump manufacturer's service booklet for servicing of Item 5 and additional repair kits.***

## Filter Assembly




**Part numbers given for MIL-PRF-5606 Fluid Type Units only.**

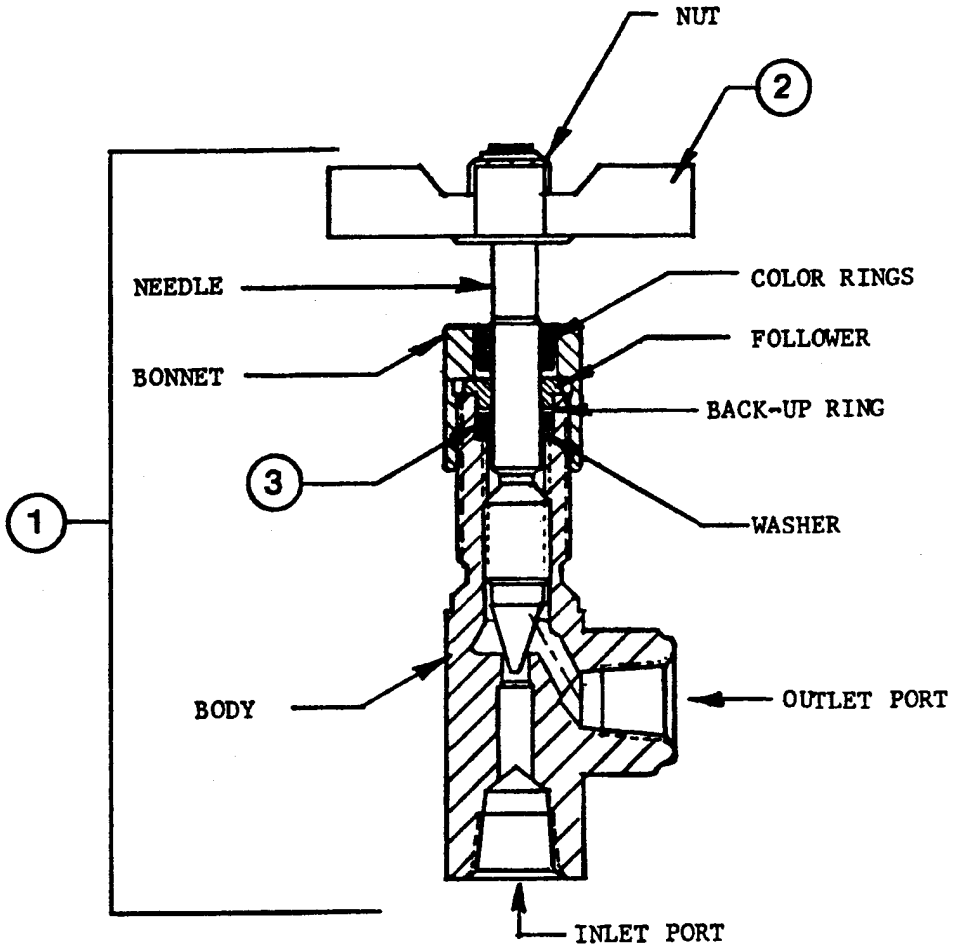
| ITEM | PART NUMBER | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | HC-1083 | Assembly, Filter | 1 |

**FILTER REPLACEMENT PARTS**

| | | | |
|---|---|---|---|
| ♦ 2 | K-1414 | Kit, Filter Element | 1 |
| 3 | HC-2000-138 | O-ring | 1 |

♦ ***Item 2 includes Item 3 O-ring.***

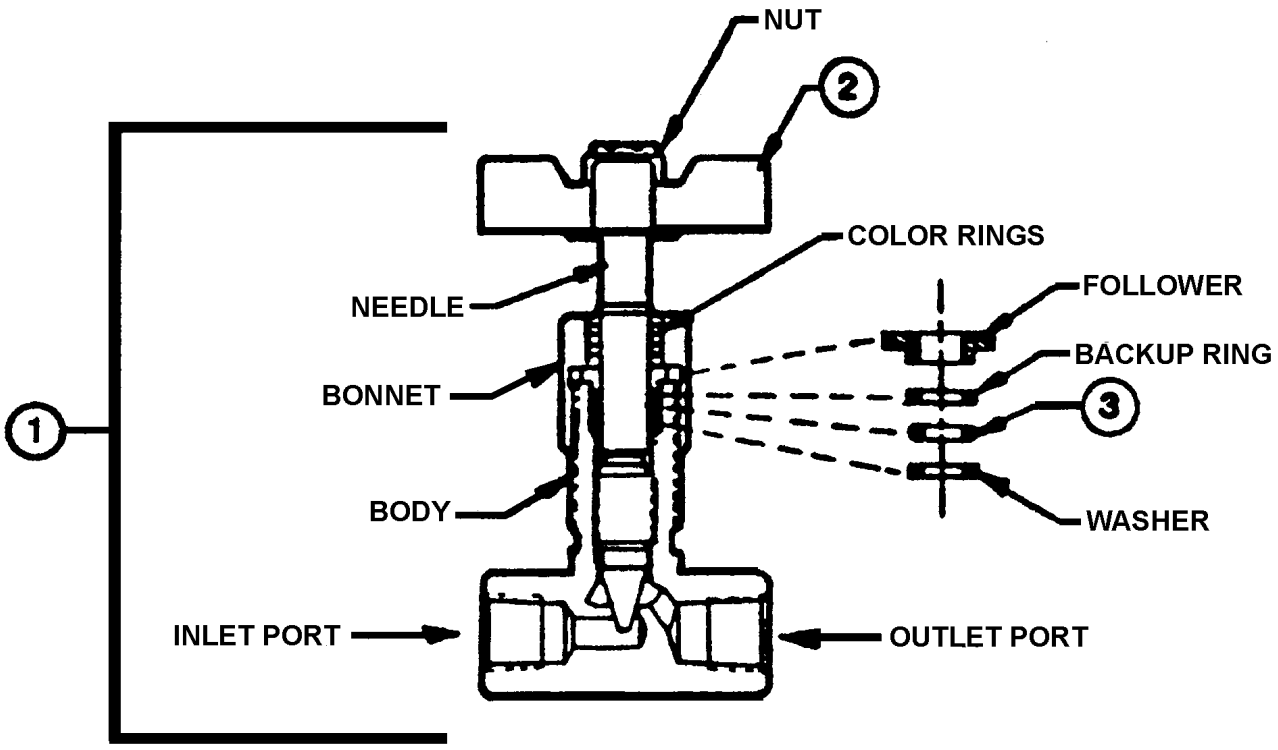
## Bypass Valve




**Part numbers given for MIL-PRF-5606 Fluid Type Units only.**

| ITEM | PART NUMBER | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | HC-1056-01 | Assembly, Valve | 1 |
| 2 | HC-1076 | Handle, Valve | 1 |
| 3 | HC-2000-012 | O-ring | 1 |

## Sample Valve



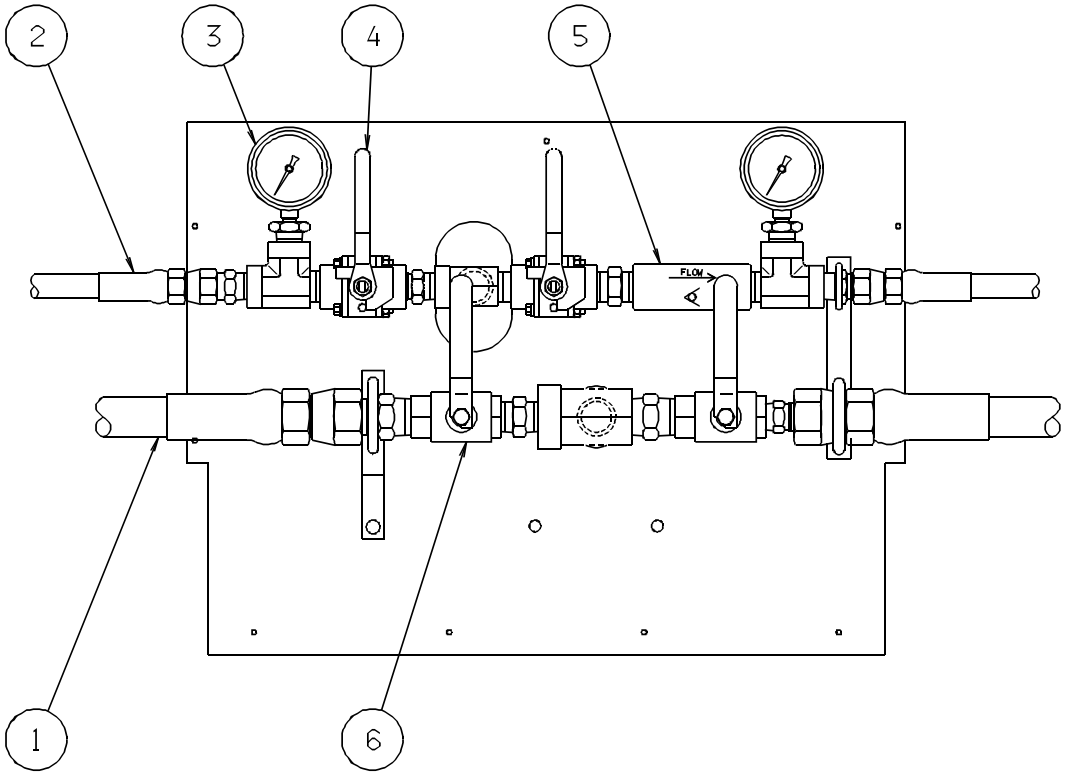

**Part numbers given for MIL-PRF-5606 Fluid Type Units only.**

| ITEM | PART NUMBER | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | HC-1202-01 | Assembly, Valve | 1 |

**VALVE REPLACEMENT PARTS**

| | | | |
|---|---|---|---|
| 2 | HC-1203 | Handle, Valve | 1 |
| 3 | HC-2000-010 | O-ring | 1 |

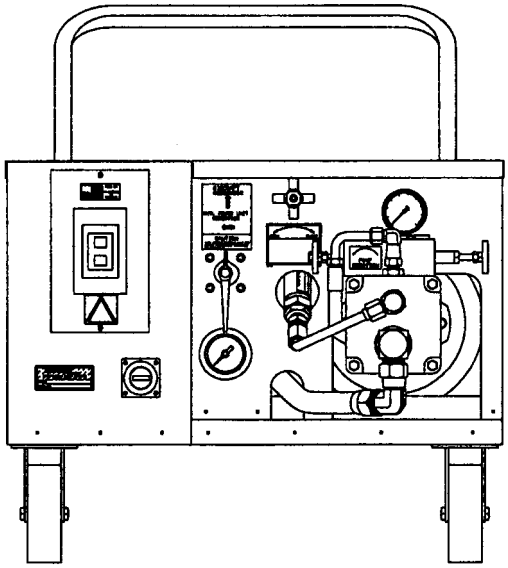
# Dual System (Option C)
# Crossover Check (Option D)

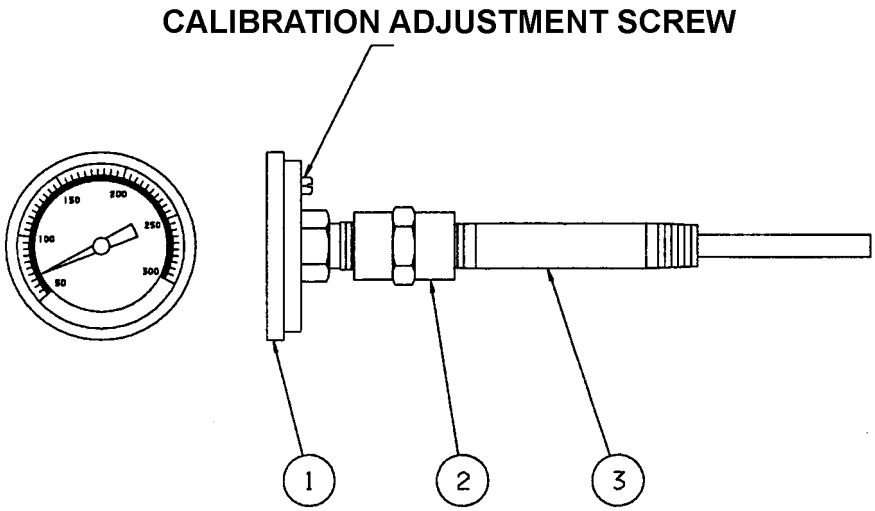



**Part numbers given for MIL-PRF-5606 Fluid Type Units only.**

| ITEM | PART NUMBER | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | TF-1039-01*180 | Assembly, Return Hose | 2 |
| 2 | TF-1037-01*180 | Assembly, Pressure Hose | 2 |
| 3 | HC-1042 | Gauge, Pressure | 2 |
| 4 | HC-1097 | Valve, Pressure Ball | 2 |
| 5 | HC-1059 | Valve, Check | 1 |
| 6 | HC-1425-04 | Valve, Return Ball | 2 |

## Pyrometer (Option K)

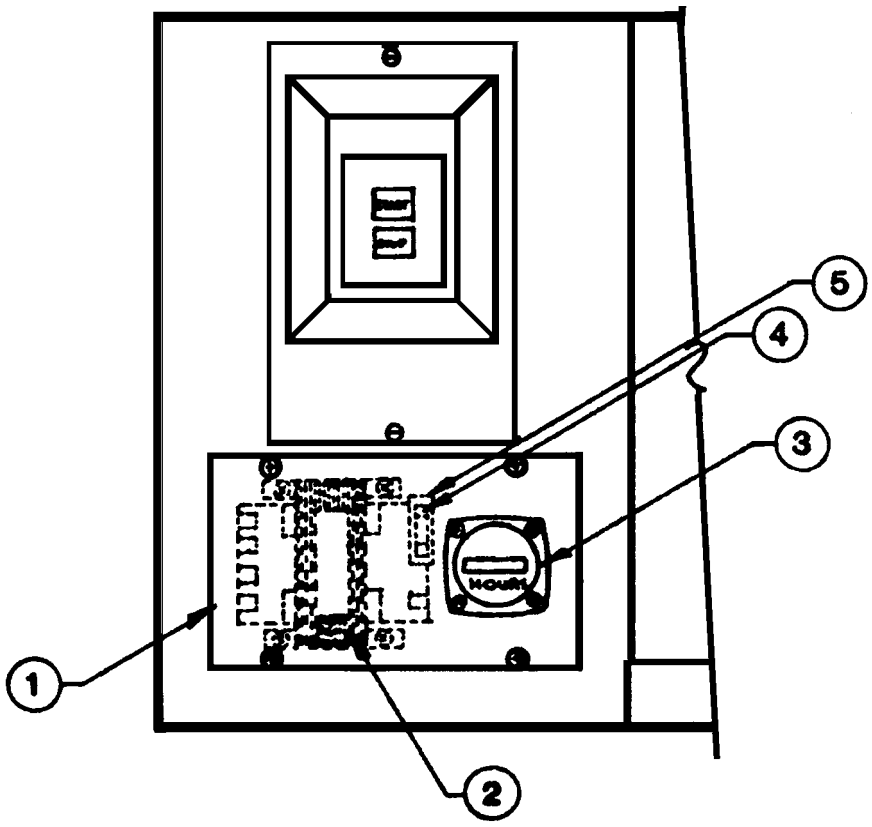





**Part numbers given for MIL-PRF-5606 Fluid Type Units only.**

| ITEM | PART NUMBER | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | HC-1093 | Pyrometer | 1 |
| 2 | N-2204-04-S | Connector, Pipe | 1 |
| 3 | N-2219-14 | Nipple, Pipe ¼" NPT x 3" long | 1 |

## Hourmeter (Option F)

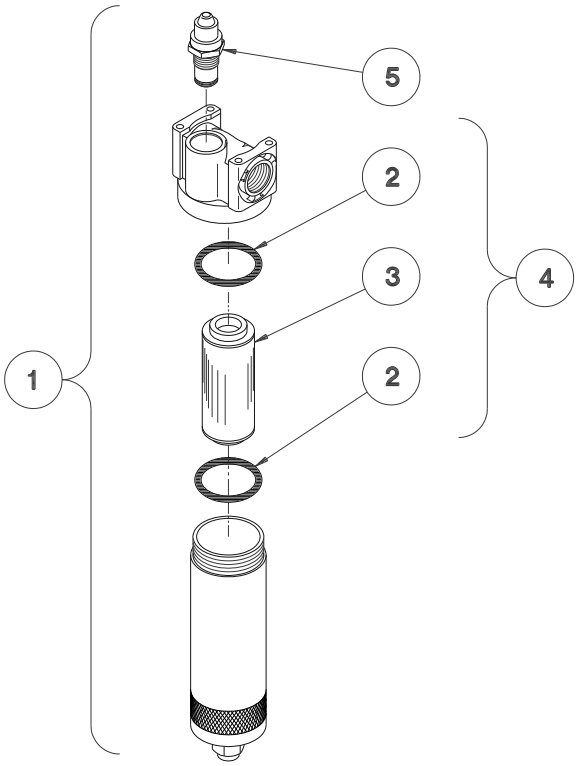



**Part numbers given for MIL-PRF-5606 Fluid Type Units only.**

| ITEM | PART NUMBER | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | S-1072 | Cover | 1 |
| 2 | EC-1070 | ♦ Transformer: 208V/60Hz, 380V/50Hz, 575V/60Hz, 415V/50Hz | 1 |
| 2 | EC-1070 | ♦ Transformer 230V/60Hz, 220V/50Hz, 460V/60Hz, 440V/50Hz | 1 |
| 3 | EC-1060 | Hourmeter | 1 |
| 4 | EC-1161 | Fuse 1½ amp, Glass Tube-Slo Blo | 1 |
| 5 | EC-1071 | Fuse Holder | 1 |

♦ ***Select one based on voltage.***

# Return Filter Assembly (Option W)




**Part numbers given for MIL-PRF-5606 Fluid Type Units only.**

| ITEM | PART NUMBER | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | HC-1453 | Assembly, Filter | 1 |
| 3 | HC-1454 | Element, Filter | 1 |

**FILTER REPLACEMENT PARTS**

| | | | | |
|---|---|---|---|---|
| | 2 | HC-2000-142 | O-ring | 2 |
| ♦ | 4 | K-3096 | Kit, Filter Element | 1 |
| | 5 | HC-1849 | Indicator, Clogging | 1 |

♦ ***Item 4 includes corresponding Item 2—O-ring.***

TRONAIR

# APPENDIX I

# Instrument Certification Notice

# Instrument Certification Notice

The gauge Certificates of Calibration supplied for the gauge(s) on this unit contain the calibration data for the actual instrument calibrated, along with the calibration date of the **STANDARD** used to perform the calibration check.

The due date for re-calibration of the instrument should be based upon the date the instrument was placed in service in your facility. Re-calibration should be done on a periodic basis as dictated by the end user's quality system or other overriding requirements.

Note that Tronair, Inc. does not supply certificates of calibration on flow meters or pyrometers unless requested at the time of placed order. These instruments are considered reference indicators only and are not critical to the test(s) being performed on the aircraft.

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TRONAIR

# APPENDIX II

# Lincoln Motor Manual

Carefully read and fully understand this Owner's Manual prior to installation, operation and maintenance of your motor.

## 1. SAFETY DEPENDS ON YOU

Lincoln motors are designed and manufactured with safety in mind. However, your overall safety can be increased by properly installing, operating and maintaining the motor. Read and observe all instructions, warnings and specific safety precautions included in this manual and THINK BEFORE YOU ACT!

## 2. RECEIVING AND INSPECTION

Check packing list and inspect motor to make certain no damage has occurred in shipment. Claims for any damage done in shipment must be made by the purchaser against the transportation company.

Turn the motor shaft by hand to be certain that it rotates freely. Be careful not to cut yourself on the shaft keyway; it is razor sharp!

Check the nameplate for conformance with power supply and control equipment requirements.

## 3. HANDLING

**⚠ WARNING**

**FALLING EQUIPMENT can injure.**

- **Lift only with equipment of adequate lifting capacity.**
- **If so equipped, use lift ring(s) on the motor to lift ONLY the motor and accessories mounted by Lincoln.**

In case of assemblies on a common base, the motor lift ring(s) CANNOT be used to lift the assembly and base but, rather, the assembly should be lifted by a sling around the base or by other lifting means provided on the base. In all cases, care should be taken to assure lifting in the direction intended in the design of the lifting means. Likewise, precautions should be taken to prevent hazardous overloads due to deceleration, acceleration or shock forces.

## 4. STORAGE

Motor stock areas should be clean, dry, vibration free and have a relatively constant ambient temperature. For added bearing protection while the motor is in storage, turn the motor shaft every six months.

A motor stored on equipment and component equipment prior to installation should be kept dry and protected from the weather. If the equipment is exposed to the atmosphere, cover the motor with a waterproof cover. Motors should be stored in the horizontal position with drains operable and positioned in the lowest point. CAUTION: Do not completely surround the motor with the protective covering. The bottom area should be open at all times.

Windings should be checked with a megohm-meter (Megger) at the time equipment is put in storage. Upon removal from storage, the resistance reading must not have dropped more than 50% from the initial reading. Any drop below this point necessitates electrical or mechanical drying. Note the sensitivity of properly connected megohm-meters can deliver erroneous values. Be sure to carefully follow the megohm-meter's operating instructions when making measurements.

All external motor parts subject to corrosion, such as the shaft and other machined surfaces, must be protected by applying a corrosion-resistant coating.

## 5. INSTALLATION

For maximum motor life, locate the motor in a clean, dry, well ventilated place easily accessible for inspecting, cleaning and lubricating. The temperature of the surrounding air should not exceed 104°F (40°C) except for motors with nameplates indicating a higher allowable maximum ambient temperature.

**⚠ WARNING**

**MOVING PARTS can injure.**

- **BEFORE starting motor, be sure shaft key is captive.**
- **Consider application and provide guarding to protect personnel.**

### 5.1 INSTALLATION – MECHANICAL

**Base**

Mount the motor on a firm foundation or base sufficiently rigid to prevent excessive vibration. On foot-mounted motors, use appropriately sized bolts through all four mounting holes. For frames which have six or eight mounting holes, use the two closest the drive shaft and two on the end opposite the drive shaft (one on each side of the frame). If necessary, properly shim the motor to prevent undue stress on the motor frame and to precision align the unit.

**Position**

Standard motors may be mounted in any position. The radial and thrust load capacity of the motor's bearing system provides for this feature.

**Drains**

All motors have drain holes located in the end brackets. As standard, drains are in place for the horizontal with feet down mounting position. Other positions may require either rotation of the end brackets or drilling additional holes to attain proper drainage. Be sure existing drain or vent holes do not permit contaminant entry when motor is mounted in the other positions.

Additional drain holes exist near the bearing cartridge in both end brackets of 284T thru 449T steel frame motors. The drain holes are closed with a plastic plug. When the motor is vertically mounted, the plug located in the lower end bracket must be removed. To access the plug on blower end, simply remove the shroud; on some models, it is also necessary to take off the blower.

**Drive – Power Transmission**

The pulley, sprocket, or gear used in the drive should be located on the shaft as close to the shaft shoulder as possible. Do not drive the unit on the shaft as this will damage the bearings. Coat the shaft lightly with heavy oil before installing pulley.

*Belt Drive:* Align the pulleys so that the belt(s) will run true. Consult the belt manufacturer's catalog for recommended tension. Properly tension the belt; excessive tension will cause premature bearing failure. If possible, the lower side of the belt should be the driving side. On multiple belt installations be sure all belts are matched for length.

*Chain Drive:* Mount the sprocket on the shaft as close to the shaft shoulder as possible. Align the sprockets so that the chain will run true. Avoid excessive chain tension.

*Gear Drive and Direct Connection:* Accurate alignment is essential. Secure the motor and driven unit rigidly to the base. Shims may be needed to achieve proper alignment.

***Excessive motor vibration may result if the full length of the motor shaft key is not completely engaged by the coupling or sheave. For these situations, adjustment of the key length is required.***

### 5.2 INSTALLATION – ELECTRICAL

**⚠ WARNING**

**ELECTRIC SHOCK can kill.**

- **Disconnect input power supply before installing or servicing motor.**
- **Motor lead connections can short and cause damage or injury if not well secured and insulated.**
- **Use washers, lock washers and the largest bolt size which will pass through the motor lead terminals in making connections.**
- **Insulate the connection, equal to or better than the insulation on the supply conductors.**
- **Properly ground the motor — see GROUNDING.**

Check power supply to make certain that voltage, frequency and current carrying capacity are in accordance with the motor nameplate.

Proper branch circuit supply to a motor should include a disconnect switch, short circuit current fuse or breaker protection, motor starter (controller) and correctly sized thermal elements or overload relay protection.

Short circuit current fuses or breakers are for the protection of the branch circuit. Starter or motor controller overload relays are for the protection of the motor.

Each of these should be properly sized and installed per the National Electrical Code and local codes.

Properly ground the motor – See GROUNDING.

#### Terminal Box

Remove the appropriate knockout. For terminal boxes without a knockout, either a threaded power-conduit entry hole is provided or the installer is responsible for supplying a correctly sized hole.

The majority of terminal boxes can be rotated in place to allow power lead entry from the 3, 6, 9 or 12 o'clock direction.

#### Motor Connection

All single speed and two-speed Lincoln motors are capable of across-the-line or autotransformer starting. Reference the lead connection diagram located on the nameplate or inside of the terminal box cover.

Single speed motors have reduced voltage start capability per the following chart.

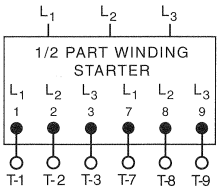
| Number of Motor Leads | Number of Rated Voltages | Lead Numbers | YDS | PWS |
|---|---|---|---|---|
| 3 | Single | 1-3 | No | No |
| 6 | Single | 1-3, 7-9 | No | Yes |
| | Single | 1-6 | Yes | No |
| | Dual | 1-6 | Yes(1) | No |
| 9 | Dual | 1-9 | No | No |
| 12 | Single | 1-12 | Yes | Yes |
| | Dual | 1-12 | Yes | No(2) |

(1) YDS capability on lower voltage only.
(2) PWS capability on lower voltage only, 1200 RPM, 324T-365T steel frame motors with Model Number efficiency letters of "S" or "H".

Contact Customer Service at 1-800-668-6748 (phone),
# 1-888-536-6867 (fax) or mailbox@lincolnmotors.com (e-mail) for a copy of across-the-line and other reduced voltage start connection diagrams.

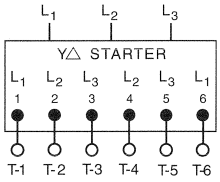
Connection Diagram 1

**Single Voltage, 6 Leads**
**Part Winding Start Connection**



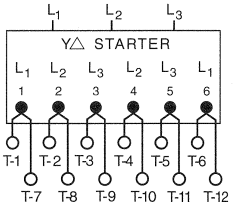

Connection Diagram 2

**Single Voltage, 6 Leads**
**Y△ Start Connection**



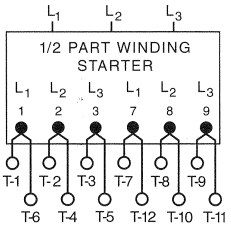

Connection Diagram 3

**Single Voltage, 12 Leads**
**Y△ Start Connection**



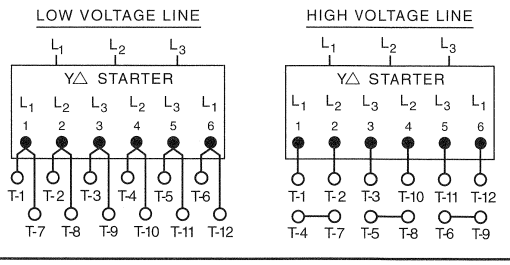

Connection Diagram 4

**Single Voltage, 12 Leads**
**Part Winding Start Connection**




Connection Diagram 5

**Dual Voltage, 12 Leads**
**Y△ Start Connection**


LOW VOLTAGE LINE
HIGH VOLTAGE LINE
L1 L2 L3
Y△ STARTER
L1 L2 L3 L2 L3 L1
1 2 3 4 5 6
T-1 T-2 T-3 T-4 T-5 T-6
T-7 T-8 T-9 T-10 T-11 T-12
T-1 T-2 T-3 T-10 T-11 T-12
T-4 T-7 T-5 T-8 T-6 T-9

### Space Heater (option)

Leads for space heaters are identified as H1 and H2. Heater voltage and watts are marked on the motor nameplate and should be checked prior to connection to power source.

### Thermostat (option)

Leads for thermostats (normally closed, automatic reset contacts) are identified as P1 and P2. Connect these to a relay or signaling device. Motor line current cannot be handled by the thermostat.

**Table 1 — Thermostat Contact Ratings**

| Voltage (60 Hz) | 110V | 220V |
|---|---|---|
| Max. Cont. Current (amps) | 3.0 | 1.5 |
| Min. Cont. Current (amps) | 0.2 | 0.1 |

### Thermistor (option)

Leads for thermistors are identified as P3 and P4. Thermistors require connection to Texas Instruments® Control Module Model 32AA or its equivalent for proper operation. This item may be purchased from Lincoln - see LC100 catalog.

### Brake (option)

Carefully read and fully understand the instructions supplied by the brake manufacturer (see inside of brake housing or separately enclosed sheet). Contact the brake manufacturer for additional information.

### GROUNDING

**⚠ WARNING**

**ELECTRIC SHOCK can kill.**

- **Connect the motor frame to a good earth ground per the National Electrical Code and local codes to limit the potential to ground in the event of contact between live electrical parts and the metal exterior.**

Lincoln motors may be electrically connected to earth ground using a terminal box mounting screw or a separate grounding screw when provided. Both are accessible inside the mounted terminal box. When a bronze mounting screw is supplied, always use it as the grounding point. In making the ground connection, the installer should make certain that there is a good electrical connection between the grounding lead and the motor.

## 6. OPERATION

Three phase squirrel cage induction motors will operate successfully, but not necessarily in accordance with nameplate ratings, at voltages 10 percent above or below nameplated value at the design frequency.

**⚠ WARNING**

**MOVING PARTS can injure.**

- **Before starting the motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off and causing bodily injury.**
- **Keep away from moving parts.**

**ELECTRIC SHOCK can kill.**

- **Do not operate with covers removed.**
- **Do not touch electrically live parts.**

After checking that the shaft key is secure, operate the motor free of load and check the direction of rotation. If the motor rotates in the wrong direction, interchange any two supply leads.

Couple the motor to its load and operate it for a minimum of one hour. During this period, check for any unusual noise or thermal conditions. Check the actual operating current to be sure that the nameplate current times service factor is not exceeded for steady continuous loads.

## 7. MAINTENANCE

**⚠ WARNING**

**ELECTRIC SHOCK can kill.**

- **Internal parts of the motor may be at line potential even when it is not rotating.**
- **Disconnect all input power to the drive and motor before performing any maintenance.**

Lincoln motors have been designed and manufactured with long motor life expectancy and trouble-free operation in mind.

Periodically inspect the motor for excessive dirt, friction or vibration. Dust may be blown from an inaccessible location using compressed air. Keep the ventilation openings clear to allow free passage of air. Make sure the drain holes in the motors are kept open and the shaft slinger is positioned against the end bracket. Grease or oil can be wiped by using a petroleum solvent.

Overheating of the bearings caused by excessive friction is usually caused by one of the following factors:

1. Bent shaft.
2. Excessive belt tension.
3. Excessive end or side thrust from the gearing, flexible coupling, etc.
4. Poor alignment.

Damaging vibrations can be caused by loose motor mountings, motor misalignment resulting from the settling or distortion of the foundation, or it may be transmitted from the driven machine. Vibration may also be caused by excessive belt or chain tension.

### BEARING SYSTEM

Lincoln motors have a high quality, premium design bearing system. Bearing sizes and enclosures are identified on most motor nameplates. The majority are double-shielded, deep-groove ball bearings. Double-sealed ball bearings are used on some motors in frames 56 and 143T thru 145T. A drive-end cylindrical roller bearing is standard on Crusher Duty motors, frames 405T and larger.

**Lubrication instructions and/or grease specifications provided on the motor supersede the following information.**

In general, the motor's bearing system has sufficient grease to last indefinitely under normal service conditions. For severe or extreme service conditions, it is advisable to add one-quarter ounce of grease to each bearing per the schedule listed in Table 2. Use a good quality, moisture-resistant, polyurea-based grease such as Chevron SRI #2. Lithium based greases are not compatible with polyurea-based greases; mixing the two types may result in the loss of lubrication.

Motors designed for low ambient applications have bearings with special low temperature grease. Use Beacon 325 lithium based grease or equivalent per the appropriate interval in Table 2.

Motors designed for high ambient applications have bearings with special high temperature grease. Use Dow Corning DC44 silicone grease or equivalent per the interval in Table 2 under "Extreme".

***Severe Service:*** Operating horizontally, 24 hours per day, vibration, dirty, dusty, high humidity, weather exposure, or ambient temperatures from 104-130°F (40-55°C).

***Extreme Service:*** Operating vertically, heavy vibration or shock, heavy duty cycle, very dirty or ambient temperatures from 130-150°F (55-65°C).

Table 2 : Bearing Lubrication Intervals

| Motor Syn Speed | Motor Horsepower | Service Conditions | |
|---|---|---|---|
| | | Severe | Extreme |
| *BALL BEARINGS* | | | |
| 1800 RPM and slower | 1/4 to 7-1/2 HP | 2 years | 6 months |
| | 10 to 40 HP | 1 year | 3 months |
| | 50 HP and up | 6 months | 3 months |
| above 1800 RPM | all sizes | 3 months | 3 months |
| *ROLLER BEARINGS* | | | |
| all speeds | all sizes | 3 months | 3 months |

When adding lubricant, keep all dirt out of the area. Wipe the fitting completely clean and use clean grease dispensing equipment. More bearing failures are caused by dirt introduced during greasing than from insufficient grease.

If the motor is equipped with a relief port or tube, make certain it is open and free of caked or hardened grease. Before replacing relief plugs, allow excess grease or pressure to vent by running the motor for several minutes after lubrication.

## ⚠ CAUTION

- **LUBRICANT SHOULD BE ADDED AT A STEADY MODERATE PRESSURE. IF ADDED UNDER HEAVY PRESSURE BEARING SHIELD(S) MAY COLLAPSE.**
- **DO NOT OVER GREASE.**

### PARTS

All parts should be ordered from Authorized Motor Warranty Stations. Call your Lincoln Motors Sales Office for location and phone number. A "Service Directory" listing all Authorized Motor Warranty Stations by geographic location is available; request Bulletin SD-6. These shops stock GENUINE Lincoln replacement parts and have factory trained personnel to service your motor.

## 8. WHO TO CALL

For the location and phone number of the Lincoln Motors District Sales Office nearest you, check your local Yellow Pages or call 1-800-MOTOR-4-U (1-800-668-6748) or visit our web site at
# www.lincolnmotors.com.

## 9. WARRANTY

Lincoln Motors, the Seller, warrants all new *standard* motors and accessories thereof against defects in workmanship and material provided the equipment has been properly cared for and operated under normal conditions. All warranty periods begin on the date of shipment to the original purchaser. Warranty periods for ***low voltage (< 600 V)*** motors are defined in the following chart. The warranty period for ***medium voltage (> 600 V)*** motors is one year on sine-wave power. Contact Lincoln for warranty period on PWM power.

| Model Number Prefix | Efficiency Code(s) | Frame Sizes | Warranty Period | |
|---|---|---|---|---|
| | | | Sine-Wave Power | PWM Power |
| AA, AF, AN | S, P, B | 143T-286T | 5 Yrs | 2 Yrs* |
| CF, SD | M | 143T-215T | 2 Yrs | 1 Yr |
| CF, CN, CS, CP | E, H, P, B | 143T-449T | 5 Yrs | 2 Yrs* |
| | | 182U-449U | 5 Yrs | 2 Yrs* |
| C5, C6 | H, P | M504-689 | 3 Yrs | Contact Lincoln # |
| MD, SE | S | 284T-445T | 5 Yrs | 1 Yr |
| RC, RJ, SC | H | 56-145T | 5 Yrs | 2 Yrs* |
| RD, RF | S | 56-56H | 5 Yrs | 2 Yrs* |
| REW, SEW | S | 56-256T | 1 Yr | 1 Yr |
| SD, SF | S, H, P, B | 143T-449T | 5 Yrs | 2 Yrs* |
| Field Kits and Accessories | | | 5 Yrs | |

* Applies to motors with a service factor of 1.15 or higher. Motors with a 1.0 service factor have a 1 year warranty on PWM power.

If the Buyer gives the Seller written notice of any defects in equipment within any period of the warranty and the Seller's inspection confirms the existence of such defects, then the Seller shall correct the defect or defects at its option, either by repair or replacement F.O.B. its own factory or other place as designated by the Seller. The remedy provided the Buyer herein for breach of Seller's warranty shall be exclusive.

No expense, liability or responsibility will be assumed by the Seller for repairs made outside of the Seller's factory without written authority from the Seller.

The Seller shall not be liable for any consequential damages in case of any failure to meet the conditions of any warranty. The liability of the Seller arising out of the supplying of said equipment or its use by the Buyer, whether on warranties or otherwise, shall not in any case exceed the cost of correcting defects in the equipment in accordance with the above guarantee. Upon the expiration of any period of warranty, all such liability shall terminate.

The foregoing guarantees and remedies are exclusive and except as above set forth there are no guarantees or warranties with respect to accessories or equipment, either expressed or arising by option of law or trade usage or otherwise implied, including with limitation the warranty of merchantability, all such warranties being waived by the Buyer.

Lincoln™ MOTORS

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**Cleveland OH 44117-2525 USA**
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**Web:** www.lincolnmotors.com
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IM566-A December 1999

# - indicates change since last printing.

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TRONAIR

# APPENDIX III

## Continental Hydraulics Service Booklet PVR6-"G" Design Series Pumps

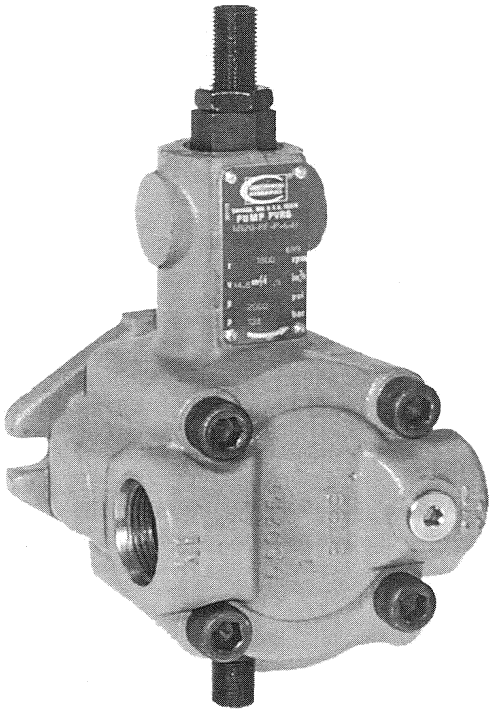
CONTINENTAL HYDRAULICS

# SERVICE MANUAL

## PVR6-Flanged Series Pump

Installation, Startup, Operating Instructions, Parts Pages, Repair Procedures

**"H" Design Series**



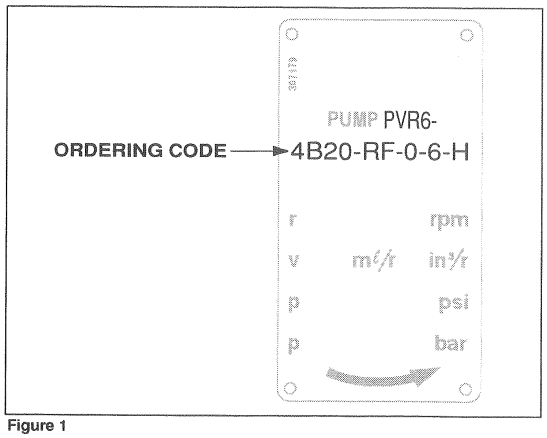
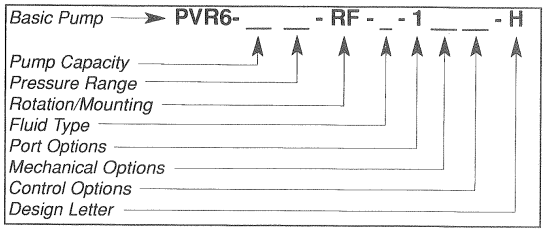



Figure 1

This service manual applies to products with Ordering Codes like the sample shown below.




**CAUTION** - Before performing any service operation on any pump, be sure that all pressure has been relieved from BOTH SIDES of the system.

**CAUTION** - Before performing any service operation on any pump, disconnect or lock off power supply.

**CAUTION** - Before starting pump, be sure that any resulting machine function will not endanger persons or equipment.

### PRODUCT IDENTIFICATION

Each pump has an Ordering Code stamped on its nameplate. See Figure 1 above for the location of the Ordering Code.

## INSTALLATION

### PUMP DRIVE AND MOUNTING

When mounting the pump and motor, care must be taken to align the pump and motor shafts within .003 T.I.R. (0.076 mm) direct inline through a jaw type/flexible web coupling. This is recommended for all pumps. Tire-type flexing elements and chain-type drives are not recommended. With belt drives, please consult factory.

To avoid axial and radical end loading of the pump shaft, do not couple the pump and motor shafts rigidly. Allow freedom at the coupling for the two shafts to ride independently.

To prevent end loading, the space between the pump and motor shaft ends should be 1/2 inch (12.7 mm) for PVR6 pumps, or as the coupling manufacturer specifies.

**PIPING AND RESERVOIR**

The pump should be mounted with a minimum number of elbows or fittings. The pump suction should be at least 1 inch (25.4 mm) tube/pipe for PVR6 pumps.

For any system and combination of piping except High Water Based Fluids (HWBF), the vacuum at the pump inlet must not exceed seven inches of Mercury, (5 inch Hg. for fire resistant fluids). HWBF Pumps are to have a positive inlet head in the range of 0.5-inch Hg. to 20 inch Hg.

Piping should be done with pickled pipe or seamless tubing free of dirt and scale. Do not use galvanized or other pipe that tends to flake off.

A 100-mesh screen (60 mesh for fire resistant and HWBF) should be used on the pump suction line. The screen should be located approximately two inches (50.8 mm) from the bottom of the tank. All lines returning oil to the tank should discharge at least two inches (50.8 mm) below the minimum oil level and should be separated from the pump suction area by means of a baffle. These lines should also include a 10-micron return line filter, with the exception of the case drain line.

The pump case drain should be connected directly to the tank. Pressure in excess of 10 psi (0.7 bar) in the case drain line can result in shaft seal leakage. It is recommended that the case drain be returned to the tank by a separate 3/8 inch (9.5 mm) line.

## STARTUP PROCEDURES

The following instructions apply for initial startup of the hydraulic pump. After an extended shutdown period, start with item 5.

**CAUTION** - Never start a new pump installation against a blocked system.

1. Check the nameplate for model number and rpm. The arrow on the pump casting indicates direction of rotation.

2. Pump suction line should extend below the lowest point of oil level but not less than two inches (50.8 mm) above reservoir bottom.

3. The pump and motor shafts must be aligned within .003 inches (0.076 mm). See Pump Drive and Mounting directions above for restrictions.

4. Connect the case drain directly to tank (or to a heat exchanger if the pump will be deadheading for long periods of time during operation), using a full-size line corresponding to the case drain in the pump or manifold. If connected to a heat exchanger, the case drain line should be protected with a 10 psi (0.7 bar) maximum relief valve in parallel with the heat exchanger. No other return lines should be connected in common with the case drain return.

5. Rotate pump and motor by hand to insure free rotation.

6. Set the machine controls to open the circuit and allow free flow from the pump back to tank or connect the pump outlet line directly to tank. Jog the motor on and off several times (on, two seconds, off three seconds) until the pump is primed. Check pump for proper direction of rotation during the jogging.

7. After the pump has been primed, run it for several minutes at lower than normal pressures with an open or intermittently open system which permits oil flow. This will purge entrapped air from the pump and system.

8. Neither volume adjustment nor pressure adjustment should be adjusted until the pump has been primed and running, and air is purged.

9. After air has been purged from the system, the system can be closed and the pump adjusted to the required operating pressure.

10. If necessary, the volume adjustment can be adjusted to the required operating pressure.

11. When replacing pumps, the suction screen in the reservoir must be removed and thoroughly cleaned. Also, the suction line from the reservoir to the pump should be flushed inside and out to remove any contaminants. Pieces of metal from a damaged pump can back up into this line. If they are not removed, they will be drawn into the new pump and destroy it. Start unit by using proper pump start-up procedure items 1 through 10.

**CAUTION** - If both pressure and volume modifications are supplied on the pump, the pressure should be adjusted before the volume. Volume should be adjusted at minimum pump pressure or at deadhead. Stop adjustment at the volume screw when pressure begins to drop.

## OPERATION

### PRESSURE AND VOLUME ADJUSTMENTS

**Pressure Control**

All pumps are adjusted to reduced pressure before shipment and must be readjusted to the required system pressure after installation and start-up.

The pressure adjusting screw is located at the end face of the compensator chamber. See parts page item number 30. The adjusting screw has a right hand thread; clockwise adjustment increases pressure; counterclockwise reduces pressure.

A pressure gauge located at the pump must be used when making adjustment to insure the pressure settings do not exceed limits specified for the particular pump of maximum system pressure.

Make all pressure settings with pump operating against a closed circuit, that is with the output of the pump blocked, and then check pressure throughout the pump flow range.

**Volume Control**

Adjust volume at minimum pump pressure or at pump deadhead. The volume adjusting screw is directly opposite the pressure adjusting screw, see parts page item number 55. The adjusting screw has a right hand thread, turning the screw clockwise decreases the maximum volume, turning the screw counterclockwise increases the maximum volume. Pumps are set at a maximum rated volume at the factory unless otherwise specified.

Stop adjustment of the volume screw when pressure begins to drop. See Sales Catalog for complete pump performance specifications.

### ADJUSTMENT PROCEDURES

To adjust the maximum output volume, use the following steps:

1. Set the pump at minimum pressure.

2. Hand tighten the volume screw until it touches the pressure ring. **NOTE:** The pump should be at full flow for this step.

3. See Pressure and Volume Adjustment Sensitivity chart below.

4. Deadhead the pump, turn the volume screw the proper number of turns to obtain the flow desired.

5. Return pump to flow condition and check flow rate. If output flow is incorrect, switch pump to deadhead and readjust per above.

**CAUTION** - Turning the maximum volume control in too far can force the pressure ring over center and destroy the pump.

### PRESSURE and VOLUME ADJUSTMENT SENSITIVITY

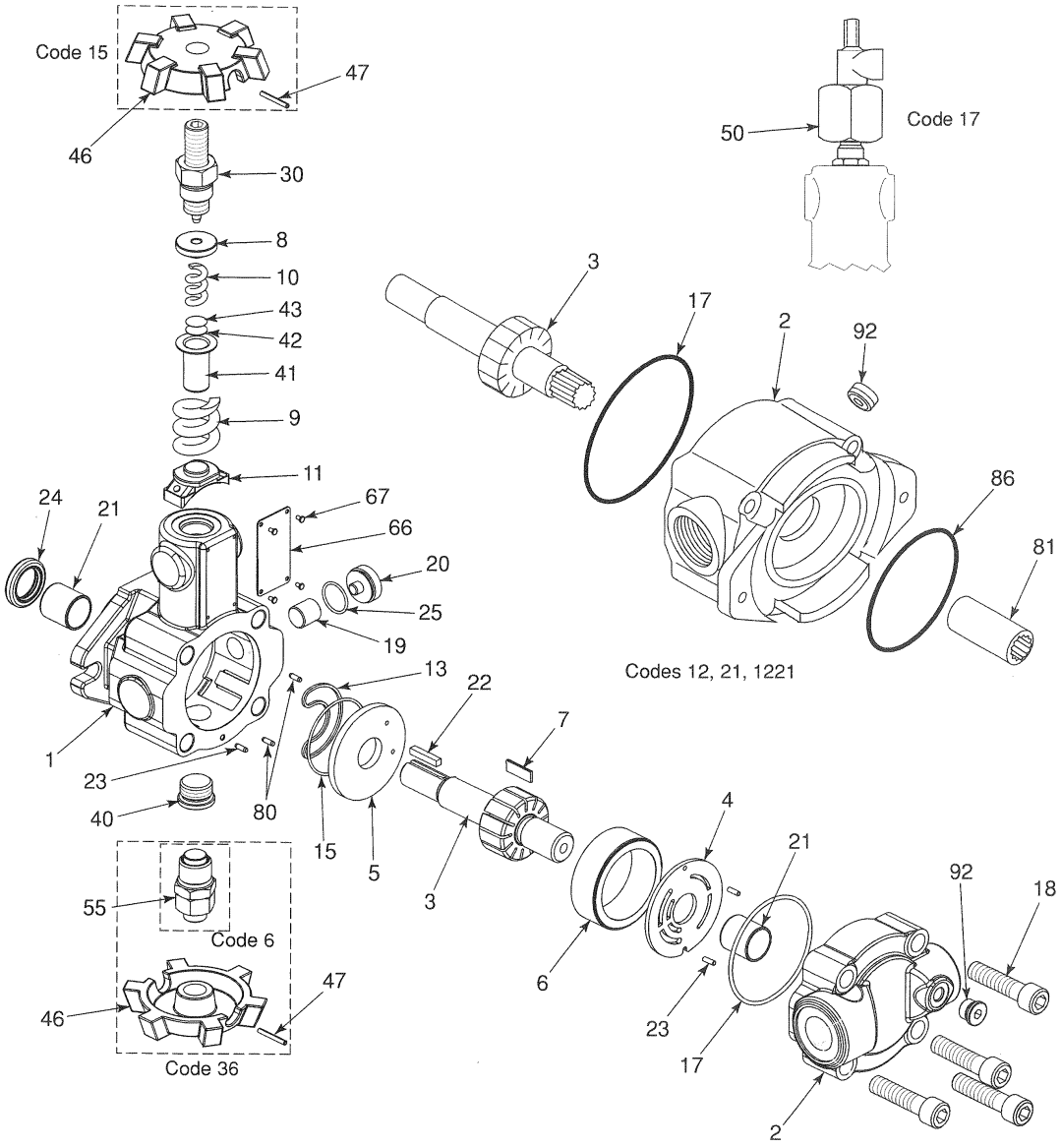
| | PUMP SIZE | | 4B | 6B | | 8B | |
|---|---|---|---|---|---|---|---|
| | PRESSURE CODE | | 20 | 06 | 15 | 06 | 15 |
| Pressure Adjustment | Pressure Change/Turn | psi (bar) | 315 (21.7) | 220 (15.2) | 315 (21.7) | 210 (14.5) | 240 (16.6) |
| | Maximum Torque | ft.-lbs. (m.kg) | 8.0 (1.10) | 2.7 (0.37) | 6.8 (0.94) | 2.7 (0.37) | 6.8 (0.94) |
| Volume Adjustment | Flow Change/Turn | gpm (lpm) | 3.4 (12.9) | 4.6 (17.4) | | 4.6 (17.4) | |
| | Approx. Min. Flow Adjust. | gpm (lpm) | 1.0 (3.7) | 1.0 (3.7) | | 1.0 (3.7) | |
| | Maximum Torque | ft.-lbs (m.kg) | 5.5 (0.76) | 3.5 (0.48) | | 3.5 (0.48) | |

## PVR6 PARTS LIST

| ITEM NO. | CODE | PART NO. | DESCRIPTION | QTY. REQ. |
|---|---|---|---|---|
| 1 | | 550177 | Pump Body | 1 |
| 1 | 4B | 550660 | Pump Body | 1 |
| 2 | | 550541 | Cover | 1 |
| 2 | 4B | 550658 | Cover | 1 |
| 2 | 6B,8B,10B; 12, 1221 | 550547 | Cover | 1 |
| 2 | 4B; 21 | 550659 | Cover | 1 |
| 3 | | 407929 | Rotorshaft | 1 |
| 3 | 4B | 407930 | Rotorshaft | 1 |
| 3 | 4B, 12 | 506066 | Rotorshaft | 1 |
| 3 | 6B,8B,10B; 12 | 506069 | Rotorshaft | 1 |
| 3 | 6B,8B,10B; 1221 | 550325 | Rotorshaft | 1 |
| 3 | 4B; 21 | 550326 | Rotorshaft | 1 |
| 3 | 6B,8B,10B; 21 | 550327 | Rotorshaft | 1 |
| 4 | 4B,6B | 550101 | Port Plate Assembly | 1 |
| 4 | 8B | 550074 | Port Plate Assembly | 1 |
| 4 | 10B | 550280 | Port Plate Assembly | 1 |
| 5 | | 550351 | Thrust Plate | 1 |
| 6 | 4B | 114592 | Pressure Ring | 1 |
| 6 | 6B | 112021 | Pressure Ring | 1 |
| 6 | 8B | 123175 | Pressure Ring | 1 |
| 6 | 10B | 251715 | Pressure Ring | 1 |
| 7 | 4B | 250516 | Vane Kit (Set of 13) | 1 |
| 7 | 6B,8B,10B | 250517 | Vane Kit (Set of 13) | 1 |
| 8 | | 306465 | Spring Seat | 1 |
| 8 | 6B3L,6B5L, 8B3L, 8B5L | 350988 | Spring Seat | 1 |
| 8 | 10B3L,10B5L | 166620 | Spring Seat | 1 |
| 9 | 4B20 | 165223 | Governor Spring | 1 |
| 9 | 6B06 | 149917 | Governor Spring | 1 |
| 9 | 8B06 | 251193 | Governor Spring | 1 |
| 9 | 6B15,8B15 | 165225 | Governor Spring | 1 |
| 9 | 6B20,8B20 | 165226 | Governor Spring | 1 |
| 9 | 6B3l,8B3L | 257653 | Governor Spring | 1 |
| 9 | 10B3L | 109792 | Governor Spring | 1 |
| 9 | 6B5L,8B5L | 255809 | Governor Spring | 1 |
| 9 | 10B5L | 113079 | Governor Spring | 1 |
| 10 | 6B06,8B06 | 165221 | Follower Spring | 1 |
| 10 | 10B10 | 165220 | Follower Spring | 1 |
| 10 | 6B15,8B15 | 165222 | Follower Spring | 1 |
| 11 | 4B | 144926 | Ring Shoe Assembly | 1 |
| 11 | 6B | 144913 | Ring Shoe Assembly | 1 |
| 11 | 8B | 162770 | Ring Shoe Assembly | 1 |
| 11 | 10B | 350448 | Ring Shoe Assembly | 1 |
| 11 | 6B3L, 6B5L | 112022 | Ring Shoe Assembly | 1 |
| 11 | 8B3L,8B5L | 123174 | Ring Shoe Assembly | 1 |
| 11 | 10B3L,10B5L | 350963 | Ring Shoe Assembly | 1 |
| 13 | | 307257 | Teflon Seal Ring | 1 |
| 15 | Buna-N | 124194 | O-Ring | 1 |
| 15 | Viton | 147177 | O-Ring | 1 |
| 17 | Buna-N | 144929 | O-Ring | 1 |
| 17 | Viton | 144966 | O-Ring | 1 |
| 18 | | 198297 | Soc. Hd. Cap Screw | 4 |
| 18 | 4B - 21; 6B, 8B, 10B; 21, 1221 | 198301 | Soc. Hd. Cap Screw | 4 |
| 19 | | 252792 | Thrust Screw | 1 |
| 20 | | 250371 | Thrust Screw Plug | 1 |
| 21 | | 163797 | Bushing | 2 |
| 22 | | 126225 | Key | 1 |
| 23 | | 004223 | Roll Pin | 3 |
| 24 | | 130795 | Lip Seal | 1 |
| 25 | Buna-N | 104617 | O-Ring | 1 |
| 25 | Viton | 166069 | O-Ring | 1 |
| 30 | | 309977 | Pressure Adj. Screw Ass'y. | 1 |
| 40 | Buna-N | 250058 | SAE O-Ring Plug | 1 |
| 40 | Viton | 254789 | SAE O-Ring plug | 1 |
| 41 | | 306466 | Spring Retainer | 1 |
| 42 | | 144927 | Shim (.005) | 1 |
| 43 | | 144928 | Shim (.0149) | 1 |
| 46 | 15, 36 | 252152 | Handwheel | 1 |
| 47 | 15, 36 | 261323 | Spring Pin | 1 |
| 50 | 17 | 350952 | Dual Pressure Control Ass'y. | 1 |
| 53 | 8, 9 | 256508 | Flow Control Valve | 1 |
| 55 | 6, 36 | 450196 | Volume Adj. Screw Ass'y. | 1 |
| 66 | | 307179 | Name Plate | 1 |
| 67 | | 250597 | Self-Tapping Screw | 4 |
| 80 | | 002586 | Dowel Pin | 2 |
| 81 | 1221, 21 | 350663 | Spline Coupling | 1 |
| 85* | 1221, 21 | 147655 | Flange Cover (Shipping) | 1 |
| 86 | Viton | 112222 | O-Ring | 1 |
| 86 | 1221, 21 | 111298 | O-Ring | 1 |
| 92 | | 256708 | SAE O-Ring Plug | 1 |
| 93* | | 166288 | Caplug (C-D) | 1 |
| 94* | | 160259 | Caplug (In) | 1 |
| 95* | | 137020 | Caplug (Out) | 1 |
| 96* | 1221, 21 | 130437 | Caplug (Flange) | 2 |
| 97* | 12, 21,1221 | 253841 | Spline Warning Tag | 1 |
| 98* | | 143391 | Grease | A.R. |
| 99* | | 132779 | LED Plate #250 | A.R. |

* Not Shown

## PVR6 PARTS DRAWING




## PVR6 KIT LIST

| WEAR PLATE KITS | |
|---|---|
| Includes Items: 4 & 5 | |
| **Model** | **Kit Number** |
| 4B | 257094 |
| 6B | 250747 |
| 8B06 | 250748 |
| 8B15 | 254700 |
| 10B10 | 254911 |

| SEAL KITS | |
|---|---|
| Includes Items: 13,15,16,17,24,28,30,55,99 | |
| **Model** | **Kit Number** |
| All Buna-N, HW | 257093 |
| All Viton | 250457 |

| VANE KITS | |
|---|---|
| Includes Items: 7 | |
| **Model** | **Kit Number** |
| 4B | 250516 |
| 6B, 8B, 10B | 250517 |

| ROTATING KITS | |
|---|---|
| Includes Items: 3, 6 & 21 | |
| **Model** | **Kit Number** |
| 4B | 250758 |
| 4B-21 | 250815 |
| 6B | 250760 |
| 6B-12 | 254763 |
| 6B-21 | 250817 |
| 8B | 250759 |
| 8B-12 | 250762 |
| 8B-21 | 250816 |
| 10B | 254912 |

| COMPLETE REBUILD KITS | |
|---|---|
| Includes Items: All Kits Listed Here Plus Item 11. | |
| **Model** | **Kit Number** |
| 4B | 257095 |
| 4B-12 | 257096 |
| 6B | 250822 |
| 6B-12 | 250826 |
| 6B-21 | 250834 |
| 8B15 | 250823 |
| 8B15-12 | 250827 |
| 10B | 254917 |
| 10B-12 | 254918 |
| 10B-21 | 254919 |

## PVR6 PUMP REPAIR PROCEDURES

### DISASSEMBLY PROCEDURE

NOTE: Disassembling pump to change components, or for any other reason, may void the warranty. Refer to Policy Statement and Discounts Summaries.

1. Remove the key (22) in the rotor shaft keyway.

2. A small amount of oil may remain in the pump. Remove the four cover bolts and slide the cover back far enough on the shaft to break the seal between the housing and cover to allow the pump to drain.

3. Remove the cover (2). Take care to avoid damage to the bearing with the end of the shaft when the cover is removed.

4. The port plate (4) may come out with the cover. Do not let it drop off the locating pins.

5. Remove the vanes (7) with a long nosed pliers or tweezers. There is one vane in each slot, 13 vanes total.

6. Remove the rotorshaft (3) from the pump. Be sure that the key (22) has been removed from the keyway so that it will not damage the shaft seals when the rotorshaft is removed.

7. Turn the pressure adjustment screw (30) counterclockwise to release the tension on the governor spring.

8. Remove the pressure ring (6), ring shoe (11), governor spring (9), retainer (41) and follower spring (10).

9. If the shaft seal (24) are to be removed they should be pushed out from the inside of the housing at this time. Care must be taken not to damage the journal bearing in the housing while the shaft seal is being removed. It is recommended that the shaft seal be replaced whenever the pump is disassembled for maintenance. The seal cannot be reused once they have been removed.

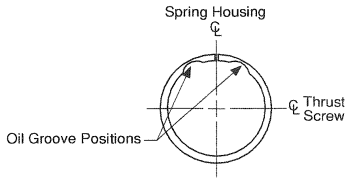
10. The bushings (21) in the pumps are assembled with a press fit. If they are to be removed at this time, the bushing in the housing should be pressed out from the front. The cover bearing should be pulled out using an expanding type puller. The bushings should not be reused once they have been removed.

11. It is unlikely that further disassembly will be necessary in order to perform routine maintenance on the pump.

### REASSEMBLY PROCEDURE

1. Clean and inspect parts to determine which parts are worn enough to require replacement.

2. Assemble the new bushings (21) in the housing and cover. The bushing OD's should be lubricated before they are pressed in the bores. Care must be taken to orient the "split" and the "oil groove" in the bushing as shown in the illustration below.




Item #21
Bushing Orientation

3. After the bearings are in place, check to see that the rotor shaft will fit into the bearings and provide a smooth turning fit. If the shaft turns hard, the bearings should be removed and the bore checked closely for nicks or burrs before pressing in the new bearings.

4. Check all of the replacement parts for nicks or burrs and then lubricate them with clean oil before reassembly.

5. Worn port and thrust plates should not be reground to clean up the wear surface. If the plates are ground, the assembly clearance will become excessive and the seal rings in the thrust plate may rupture. Replace worn port and thrust plates if necessary.

6. Assemble the springs (9, 10) and ring shoe (11), pressure ring (6) and rotorshaft (3).

7. To assure proper vane assembly, place the vanes (7) with the beveled edge out against the pressure ring.

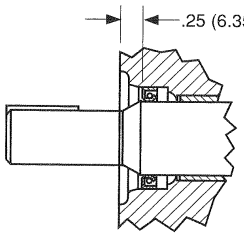
8. Assemble the square seal rings into the cavity in the back of the thrust plate. The soft rubber seal ring (15) should be assembled first and the hard seat ring (13) should be assembled on top of them. Stretch the larger soft seal ring slightly so it clings to the ID at the cavity. Apply clean oil or STP to the back of the thrust plate before it is placed in the locating pins in the body to help hold the parts together while they are assembled.

9. Before fitting the cover into the housing, check to assure that the bore in the port plate is concentric to the bearing bore in the cover. If the bores are not concentric, the port place must be relocated 180° on the locating pins.

10. Assemble the cover (2) and port plate (4) onto the housing and align the bolt holes. Rotate the shaft (3) as the bolts are tightened to assure that the vanes are not cocked.

11. Torque the cover bolts (18) to 50 lbs-ft (67.8 Nm). The shaft should turn by hand when assembly is complete.

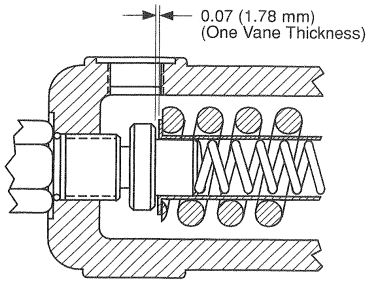
12. Lubricate the ID of the shaft seal (24) and press it into the housing to the depth shown below. Note the "lip to the inside" orientation of the seal.




13. Adjust the pressure adjustment screw (30) until it just touches the spring and then give it one more turn clockwise.

14. Turn pump upside down. Pour one cup of good grade hydraulic fluid into the intake port while slowly rotating the shaft in the direction shown by the rotation arrow.

15. The pump is now ready to test. Refer to front of this manual for start-up procedure.



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Because Continental Hydraulics is continually improving its' products, specifications and appearance are subject to change without notice.



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# APPENDIX IV

## MSDS
## Hydraulic
## Fluid

ExxonMobil

# MATERIAL SAFETY DATA SHEET

## SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

**PRODUCT**

**Product Name:** **MOBIL AERO HFA**
**Product Description:** Base Oil and Additives
**Product Code:** 490110-00, 970584
**Intended Use:** Aviation hydraulic oil

**COMPANY IDENTIFICATION**

**Supplier:** **EXXON MOBIL CORPORATION**
3225 GALLOWS RD.
FAIRFAX, VA. 22037 USA

| | |
|---|---|
| **24 Hour Health Emergency** | 609-737-4411 |
| **Transportation Emergency Phone** | 800-424-9300 |
| **ExxonMobil Transportation No.** | 281-834-3296 |
| **MSDS Requests** | 713-613-3661 |
| **Product Technical Information** | 800-662-4525, 800-947-9147 |
| **MSDS Internet Address** | http://www.exxon.com, http://www.mobil.com |

## SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

**Reportable Hazardous Substance(s) or Complex Substance(s)**

| Name | CAS# | Concentration* |
|---|---|---|
| DISTILLATES (PETROLEUM), HYDROTREATED LIGHT | 64742-47-8 | 10 - 30% |
| HYDROTREATED LIGHT NAPHTHENIC DISTILLATE (PETROLEUM) | 64742-53-6 | 30 - 60% |
| HYDROTREATED LIGHT PARAFFINIC DISTILLATES, PETROLEUM | 64742-55-8 | 10 - 30% |

* All concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

## SECTION 3 HAZARDS IDENTIFICATION

This material is considered to be hazardous according to regulatory guidelines (see (M)SDS Section 15).

**POTENTIAL PHYSICAL / CHEMICAL EFFECTS**

Combustible. Material can release vapors that readily form flammable mixtures. Vapor accumulation could flash and/or explode if ignited.

**POTENTIAL HEALTH EFFECTS**

If swallowed, may be aspirated and cause lung damage. Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis. May be irritating to the eyes, nose, throat, and lungs. High-pressure injection under skin may cause serious damage.

**Target Organs:** Skin |

| | | | | | |
|---|---|---|---|---|---|
| **NFPA Hazard ID:** | Health: | 0 | Flammability: | 2 | Reactivity: 0 |
| **HMIS Hazard ID:** | Health: | 0* | Flammability: | 2 | Reactivity: 0 |

**NOTE:** This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

## SECTION 4 FIRST AID MEASURES

### INHALATION
Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

### SKIN CONTACT
Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

### EYE CONTACT
Flush thoroughly with water. If irritation occurs, get medical assistance.

### INGESTION
Seek immediate medical attention. Do not induce vomiting.

### NOTE TO PHYSICIAN
If ingested, material may be aspirated into the lungs and cause chemical pneumonitis. Treat appropriately.

## SECTION 5 FIRE FIGHTING MEASURES

### EXTINGUISHING MEDIA
**Appropriate Extinguishing Media:** Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

**Inappropriate Extinguishing Media:** Straight Streams of Water

### FIRE FIGHTING
**Fire Fighting Instructions:** Evacuate area. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply. Firefighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

**Unusual Fire Hazards:** Combustible. Pressurized mists may form a flammable mixture.

**Hazardous Combustion Products:** Smoke, Fume, Sulfur oxides, Aldehydes, Incomplete combustion products, Oxides of carbon, Phosphorus oxides

### FLAMMABILITY PROPERTIES
**Flash Point [Method]:** >82C (180F) [ ASTM D-93]
**Flammable Limits (Approximate volume % in air):** LEL: 0.7 UEL: 7.0
**Autoignition Temperature:** >225C (437F)

## SECTION 6 ACCIDENTAL RELEASE MEASURES

### NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations. U.S. regulations require reporting releases of this material to the environment which exceed the reportable quantity or oil spills which could reach any waterway including intermittent dry creeks. The National Response Center can be reached at (800)424-8802.

### PROTECTIVE MEASURES

Avoid contact with spilled material. Warn or evacuate occupants in surrounding and downwind areas if required due to toxicity or flammability of the material. See Section 5 for fire fighting information. See Section 3 for Significant Hazards. See Section 4 for First Aid Advice. See Section 8 for Personal Protective Equipment.

### SPILL MANAGEMENT

**Land Spill:** Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Stop leak if you can do it without risk. All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Prevent entry into waterways, sewer, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. Use clean non-sparking tools to collect absorbed material. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Large Spills: Water spray may reduce vapor; but may not prevent ignition in closed spaces. Recover by pumping or with suitable absorbent.

**Water Spill:** Stop leak if you can do it without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

### ENVIRONMENTAL PRECAUTIONS

Large Spills: Dike far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

## SECTION 7 HANDLING AND STORAGE

### HANDLING

Avoid contact with skin. Avoid prolonged breathing of mists and heated vapor. Use proper bonding and/or grounding procedures. Prevent small spills and leakage to avoid slip hazard.

**Static Accumulator:** This material is a static accumulator.

### STORAGE

Keep container closed. Handle containers with care. Open slowly in order to control possible pressure release. Store in a cool, well-ventilated area. Storage containers should be grounded and bonded. Drums must be grounded and bonded and equipped with self-closing valves, pressure vacuum bungs and flame arresters.

## SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

### EXPOSURE LIMIT VALUES

**Exposure limits/standards (Note: Exposure limits are not additive)**

| Source | Form | Limit / Standard | | | Note | Source |
|---|---|---|---|---|---|---|
| HYDROTREATED LIGHT NAPHTHENIC DISTILLATE (PETROLEUM) | | TWA | 2000 mg/m3 | 500 ppm | N/A | OSHA Z1 |
| HYDROTREATED LIGHT NAPHTHENIC DISTILLATE (PETROLEUM) | Mist. | STEL | 10 mg/m3 | | N/A | ACGIH |
| HYDROTREATED LIGHT NAPHTHENIC DISTILLATE (PETROLEUM) | Mist. | TWA | 5 mg/m3 | | N/A | ACGIH |
| HYDROTREATED LIGHT PARAFFINIC DISTILLATES, PETROLEUM | Mist. | STEL | 10 mg/m3 | | N/A | ACGIH |
| HYDROTREATED LIGHT PARAFFINIC DISTILLATES, PETROLEUM | Mist. | TWA | 5 mg/m3 | | N/A | ACGIH |

**Exposure limits/standards for materials that can be formed when handling this product:** When mists / aerosols can occur, the following are recommended: 5 mg/m³ - ACGIH TLV, 10 mg/m³ - ACGIH STEL, 5 mg/m³ - OSHA PEL.

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

### ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

Use explosion-proof ventilation equipment to stay below exposure limits.

### PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

**Respiratory Protection:** If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapor warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

**Hand Protection:** Any specific glove information provided is based on published literature and glove manufacturer data. Work conditions can greatly effect glove durability; inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

If prolonged or repeated contact is likely, chemical resistant gloves are recommended. If contact with forearms is likely, wear gauntlet style gloves.

**Eye Protection:** If contact is likely, safety glasses with side shields are recommended.

**Skin and Body Protection:** Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:
If prolonged or repeated contact is likely, chemical, and oil resistant clothing is recommended.

**Specific Hygiene Measures:** Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping.

**ENVIRONMENTAL CONTROLS**
See Sections 6, 7, 12, 13.

## SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

**Typical physical and chemical properties are given below. Consult the Supplier in Section 1 for additional data.**

**GENERAL INFORMATION**
**Physical State:** Liquid
**Color:** Red
**Odor:** Characteristic
**Odor Threshold:** N/D

**IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION**
**Relative Density (at 15 C):** 0.88
**Flash Point [Method]:** >82C (180F) [ASTM D-93]
**Flammable Limits (Approximate volume % in air):** LEL: 0.7 UEL: 7.0
**Autoignition Temperature:** >225°C (437°F)
**Boiling Point / Range:** N/D
**Vapor Density (Air = 1):** N/D
**Vapor Pressure:** [N/D at 20 °C]
**Evaporation Rate (n-butyl acetate = 1):** N/D
**pH:** N/A
**Log Pow (n-Octanol/Water Partition Coefficient):** N/D
**Solubility in Water:** Negligible
**Viscosity:** 13.8 cSt (13.8 mm2/sec) at 40 C | 5.1 cSt (5.1 mm2/sec) at 100C
**Oxidizing Properties:** See Sections 3, 15, 16.

**OTHER INFORMATION**
**Freezing Point:** N/D
**Melting Point:** N/A
**Pour Point:** -60°C (-76°F)
**DMSO Extract (mineral oil only), IP-346:** < 3 %wt

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## SECTION 10 STABILITY AND REACTIVITY

**STABILITY:** Material is stable under normal conditions.

**CONDITIONS TO AVOID:** Open flames and high energy ignition sources.

**MATERIALS TO AVOID:** Strong oxidizers

**HAZARDOUS DECOMPOSITION PRODUCTS:** Material does not decompose at ambient temperatures.

**HAZARDOUS POLYMERIZATION:** Will not occur.

## SECTION 11 TOXICOLOGICAL INFORMATION

**ACUTE TOXICITY**

| Route of Exposure | Conclusion / Remarks |
|---|---|
| **Inhalation** | |
| Toxicity (Rat): LC50 > 5000 mg/m3 | Minimally Toxic. Based on assessment of the components. |
| Irritation: No end point data. | Elevated temperatures or mechanical action may form vapors, mist, or fumes which may be irritating to the eyes, nose, throat, or lungs. Based on assessment of the components. |
| | |
| **Ingestion** | |
| Toxicity (Rat): LD50 > 2000 mg/kg | Minimally Toxic. Based on test data for structurally similar materials. |
| | |
| **Skin** | |
| Toxicity (Rabbit): LD50 > 2000 mg/kg | Minimally Toxic. Based on test data for structurally similar materials. |
| Irritation (Rabbit): Data available. | Negligible irritation to skin at ambient temperatures. Based on assessment of the components. |
| | |
| **Eye** | |
| Irritation (Rabbit): Data available. | May cause mild, short-lasting discomfort to eyes. Based on assessment of the components. |

**CHRONIC/OTHER EFFECTS**

**For the product itself:**

Repeated and/or prolonged exposure may cause irritation to the skin, eyes, or respiratory tract. Small amounts of liquid aspirated into the lungs during ingestion or from vomiting may cause chemical pneumonitis or pulmonary edema.

**Contains:**

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitizing in test animals.

Additional information is available by request.

**The following ingredients are cited on the lists below:** None.

--REGULATORY LISTS SEARCHED--

| | | |
|---|---|---|
| 1 = NTP CARC | 3 = IARC 1 | 5 = IARC 2B |
| 2 = NTP SUS | 4 = IARC 2A | 6 = OSHA CARC |

Material -- Expected to be harmful to aquatic organisms. May cause long-term adverse effects in the aquatic environment.

**MOBILITY**

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

**PERSISTENCE AND DEGRADABILITY**

**Biodegradation:**

Base oil component -- Expected to be inherently biodegradable

**BIOACCUMULATION POTENTIAL**

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

## SECTION 13 DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

**DISPOSAL RECOMMENDATIONS**

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

**REGULATORY DISPOSAL INFORMATION**

RCRA Information: The unused product, in our opinion, is not specifically listed by the EPA as a hazardous waste (40 CFR, Part 261D), nor is it formulated to contain materials which are listed as hazardous wastes. It does not exhibit the hazardous characteristics of ignitability, corrositivity or reactivity and is not formulated with contaminants as determined by the Toxicity Characteristic Leaching Procedure (TCLP). However, used product may be regulated.

**Empty Container Warning** Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

## SECTION 14 TRANSPORT INFORMATION

**LAND (DOT)** : Not Regulated for Land Transport

**LAND (TDG)** : Not Regulated for Land Transport

**SEA (IMDG)** : Not Regulated for Sea Transport according to IMDG-Code

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## SECTION 14 TRANSPORT INFORMATION

**LAND (DOT)**

**Proper Shipping Name:** COMBUSTIBLE LIQUID, N.O.S. (Distillates (Petroleum), Hydrotreated Light )
**Hazard Class & Division:** COMBUSTIBLE LIQUID
**ID Number:** NA1993
**Packing Group:** III
**ERG Number:** 128
**Label(s):** NONE
**Transport Document Name:** NA1993, COMBUSTIBLE LIQUID, N.O.S. (Distillates (Petroleum), Hydrotreated Light), COMBUSTIBLE LIQUID, PG III

Footnote: This material is not regulated under 49 CFR in a container of 119 gallon capacity or less when transported solely by land, as long as the material is not a hazardous waste, a marine pollutant, or specifically listed as a hazardous substance.

**LAND (TDG)** : Not Regulated for Land Transport

**SEA (IMDG)** : Not Regulated for Sea Transport according to IMDG-Code

**AIR (IATA)** : Not Regulated for Air Transport

## SECTION 15 REGULATORY INFORMATION

**OSHA HAZARD COMMUNICATION STANDARD:** When used for its intended purpose, this material is classified as hazardous in accordance with OSHA 29CFR 1910.1200.

**NATIONAL CHEMICAL INVENTORY LISTING:** AICS, IECSC, DSL, EINECS, ENCS, KECI, PICCS, TSCA

**EPCRA:** This material contains no extremely hazardous substances.

**SARA (311/312) REPORTABLE HAZARD CATEGORIES:** Fire. Delayed Health.

**SARA (313) TOXIC RELEASE INVENTORY:** This material contains no chemicals subject to the supplier notification requirements of the SARA 313 Toxic Release Program.

**The Following Ingredients are Cited on the Lists Below:**

| Chemical Name | CAS Number | List Citations |
|---|---|---|
| DISTILLATES (PETROLEUM), HYDROTREATED LIGHT | 64742-47-8 | 17, 18, 19 |
| HYDROTREATED LIGHT NAPHTHENIC DISTILLATE (PETROLEUM) | 64742-53-6 | 1, 4, 13, 17, 18 |
| HYDROTREATED LIGHT PARAFFINIC DISTILLATES, PETROLEUM | 64742-55-8 | 1, 17, 18 |

--REGULATORY LISTS SEARCHED--

| | | | |
|---|---|---|---|
| 1 = ACGIH ALL | 6 = TSCA 5a2 | 11 = CA P65 REPRO | 16 = MN RTK |
| 2 = ACGIH A1 | 7 = TSCA 5e | 12 = CA RTK | 17 = NJ RTK |
| 3 = ACGIH A2 | 8 = TSCA 6 | 13 = IL RTK | 18 = PA RTK |
| 4 = OSHA Z | 9 = TSCA 12b | 14 = LA RTK | 19 = RI RTK |
| 5 = TSCA 4 | 10 = CA P65 CARC | 15 = MI 293 | |

Code key: CARC=Carcinogen; REPRO=Reproductive

## SECTION 16 OTHER INFORMATION

N/D = Not determined, N/A = Not applicable

**THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:**
Revision Changes:
Section 05: Fire Fighting Measures - Unusual Fire Hazards was modified.
Section 10: Conditions to Avoid was modified.
Section 07: Handling and Storage - Handling was modified.
Section 07: Handling and Storage - Storage Phrases was modified.
Section 03: HMIS Flammability was modified.
Section 03: NFPA Flammability was modified.
Section 06: Accidental Release - Spill Management - Land was modified.
Section 09: Flash Point C(F) was modified.
Section 08: Exposure Control was modified.
Section 15: SARA (311/312) REPORTABLE HAZARD CATEGORIES was modified.
Section 16: Land Spill was modified.
Section 14: DOT Technical Name - All was added.
Section 03: Physical/Chemical Hazard was added.
Section 14: Proper Shipping Name - Header was added.
Section 14: Proper Shipping Name was added.
Section 14: Hazard Class & Division - Header was added.
Section 14: Hazard Class was added.
Section 14: UN Number - Header was added.
Section 14: UN Number was added.
Section 14: Packing Group - Header was added.
Section 14: Packing Group was added.
Section 14: Label(s) - Header was added.
Section 14: Label(s) was added.
Section 14: ERG Number - Header was added.
Section 14: ERG Number was added.
Section 14: Transport Document Name - Header was added.
Section 14: Transport Document Name was added.
Section 14: DOT Technical Name - Open parenthesis was added.
Section 14: DOT Technical Name - Close parenthesis was added.
Section 03: Physical/Chemical Hazard was added.
Section 03: Physical/Chemical Hazards - Header was added.
Section 14: DOT Footnote was added.
Section 16: Physical Hazards was added.
Section 16: Physical Hazards - Header was added.
Section 16: Precautions was added.
Section 16: Precautions - Header was added.
Section 10: Conditions to Avoid was deleted.
Section 14: LAND (DOT) - Default was deleted.

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**PRECAUTIONARY LABEL TEXT:**
**Contains:** DISTILLATES (PETROLEUM), HYDROTREATED LIGHT
CAUTION!

**HEALTH HAZARDS**
Repeated exposure may cause skin dryness or cracking. If swallowed, may be aspirated and cause lung damage.
**Target Organs:** Skin |

**PHYSICAL HAZARDS**
Combustible.

**PRECAUTIONS**
Use proper bonding and/or grounding procedures.

**FIRST AID**
**Inhalation:** Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

**Eye:** Flush thoroughly with water. If irritation occurs, get medical assistance.

**Oral:** Seek immediate medical attention. Do not induce vomiting. If ingested, material may be aspirated into the lungs and cause chemical pneumonitis. Treat appropriately.

**Skin:** Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

**FIRE FIGHTING MEDIA**
Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

**SPILL/LEAK**
**Land Spill:** Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Stop leak if you can do it without risk. Prevent entry into waterways, sewer, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Recover by pumping or with suitable absorbent.

**Water Spill:** Stop leak if you can do it without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.
**Use**
Not intended or suitable for use in or around a household or dwelling.

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